Technische Universität Hamburg-Harburg

Module Manual

Bachelor of Science

General Engineering Science (English program)

Winter Term 2014

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Module: Signals and Systems 361
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Module: Heat Transfer 376
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Module: Fundamentals of Process Engineering 413
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Program description

Content:
The Bachelor-program General Engineering Science (GES) starts with a broad, for all students binding fundamental engineering curricula. With begin of the 3rd Semester students have to choose one of the 9 fields of study, some of them with further specialisations. GES is designed as an intensive course of studies, with a higher workload than 180 credit points. The Bachelor degree in one of the fields of study enables a consecutive study of one of the corresponding Master studyies, of another technical or of an economic oriented Master study. Most of the modules in the 1st and the 2nd semester of GES are offered in English.
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Core qualification

Module: Chemistry (GES)

Courses:

Title	Typ	Hrs/wk
Chemistry (GES) I	Vorlesung	2
Chemistry (GES) I	Hörsaalübung	1
Chemistry (GES) II	Vorlesung	2
Chemistry (GES) II	Hörsaalübung	1

Module Responsibility:
NN

Admission Requirements:
None

Recommended Previous Knowledge:
None

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Capabilities:

Personal Competence:
Social Competence:
Autonomy:

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 96, Study Time in Lecture: 84

Assignment for the Following Curricula:
General Engineering Science (English program): Kernqualifikation: Compulsory

Course: Chemistry (GES) I (Vorlesung)

Lecturer:
Dr. Christoph Wutz

Language:
EN

Cycle:
WS

Content:
- Structure of matter
- Periodic table
- Electronegativity
- Chemical bonds
- Solid compounds and solutions
- Chemistry of water
- Chemical reactions and equilibria
- Acid-base reactions
- Redox reactions

Literature:
- Gallagher, Ingram: Complete Chemistry (Oxford University Press)

- Corwin: Introductory Chemistry (Pearson)

- Burrows, Parsons, Price,Holman: Chemistry3 (Oxford University Press)

Course: Chemistry (GES) I (Ubung)

Lecturer:
Dr. Christoph Wutz

Language:
EN

Cycle:
WS

Content:
- Structure of matter
- Periodic table
- Electronegativity
- Chemical bonds
- Solid compounds and solutions
- Chemistry of water
- Chemical reactions and equilibria
- Acid-base reactions
- Redox reactions

Literature:
- Gallagher, Ingram: Complete Chemistry (Oxford University Press)

- Corwin: Introductory Chemistry (Pearson)

- Burrows, Parsons, Price,Holman: Chemistry3 (Oxford University Press)

Course: Chemistry (GES) II (Vorlesung)

Lecturer:
Dr. Christoph Wutz

Language:
EN

Cycle:
WS

Content:
- Simple compounds of carbon, aliphatic hydrocarbons, aromatic hydrocarbons,
- Alkohols, phenols, ether, aldehydes, ketones, carbonic acids, ester, amines, amino acids, fats, sugars
- Reaction mechanisms, radical reactions, nucleophilic substitution, elimination reactions, addition reaction
- Practical apllications and examples

Literature:
- Gallagher, Ingram: Complete Chemistry (Oxford University Press)

- Corwin: Introductory Chemistry (Pearson)

- Burrows, Parsons, Price,Holman: Chemistry3 (Oxford University Press)

Course: Chemistry (GES) II (Übung)

Lecturer:
Dr. Christoph Wutz

Language:
EN

Cycle:
WS

Content:
- Simple compounds of carbon, aliphatic hydrocarbons, aromatic hydrocarbons,
- Alkohols, phenols, ether, aldehydes, ketones, carbonic acids, ester, amines, amino acids, fats, sugars
- Reaction mechanisms, radical reactions, nucleophilic substitution, elimination reactions, addition reaction
- Practical apllications and examples

Literature:
- Gallagher, Ingram: Complete Chemistry (Oxford University Press)

- Corwin: Introductory Chemistry (Pearson)

- Burrows, Parsons, Price,Holman: Chemistry3 (Oxford University Press)

Module: Linear Algebra

Courses:

Title	Typ	Hrs/wk
Linear Algebra	Vorlesung	4
Linear Algebra	Hörsaalübung	2
Linear Algebra	Gruppenübung	2

Module Responsibility:
NN

Admission Requirements:

Recommended Previous Knowledge:
School mathematics

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:

- Students can name the basic concepts in linear algebra. They are able to explain them using appropriate examples.
- Students can discuss logical connections between these concepts. They are capable of illustrating these connections with the help of examples.
- They know proof strategies and can reproduce them.

Capabilities:

- Students can model problems in linear algebra with the help of the concepts studied in this course. Moreover, they are capable of solving them by applying established methods.
- Students are able to discover and verify further logical connections between the concepts studied in the course.
- For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results.

Personal Competence:
Social Competence:
Autonomy:

ECTS-Credit points:
8 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 128, Study Time in Lecture: 112

Assignment for the Following Curricula:
Computer Science: Kernqualifikation: Compulsory
General Engineering Science (English program): Kernqualifikation: Compulsory

Course: Linear Algebra (Vorlesung)

Lecturer:
NN

Language:
EN

Cycle:
WS

Content:
Preliminaries
Vector spaces
Matrices and linear systems of equations
Scalar products and orthogonality
Basis transformation
Determinants
Eigen values

Literature:

Strang: Linear Algebra
Beutelsbacher: Lineare Algebra

Course: Linear Algebra (Übung)

Lecturer:
NN

Language:
EN

Cycle:
WS

Content:
Preliminaries
Vector spaces
Matrices and linear systems of equations
Scalar products and orthogonality
Basis transformation
Determinants
Eigen values

Literature:
Strang: Linear Algebra
Beutelsbacher: Lineare Algebra

Course: Linear Algebra (Übung)

Lecturer:
NN

Language:
EN

Cycle:
WS

Content:
Preliminaries
Vector spaces
Matrices and linear systems of equations
Scalar products and orthogonality
Basis transformation
Determinants
Eigen values

Literature:
Strang: Linear Algebra
Beutelsbacher: Lineare Algebra

Module: Electrical Engineering I

Courses:

Title	Typ	Hrs/wk
Electrical Engineering I	Vorlesung	3
Electrical Engineering I	Gruppenübung	2

Module Responsibility:
Prof. Manfred Kasper

Admission Requirements:

Recommended Previous Knowledge:

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students know the basic theory, relations and methods of direct current networks and of electric and magnetic fields. This includes especially:

- Kirchhoff's voltage and current laws,
- Ohm's law,
- methods to simplify and analyze direct current networks,
- description of electric and magnetic fields by use of vectorial field quantities,
- Basic material relations,
- Gauss's law,
- Ampère's law,
- induction law,
- Maxwell's equation in the integral form,
- concept and definition of resistance, capacitance and inductance.

Capabilities:
The students are able to establish relations between currents and voltages in simple direct current networks and to apply these to calculate and dimension networks. Student know to apply the fundamental laws of electric and magnetic fields and are able to derive and evaluate relations between field quantities. Students know to calculate resistance, capacitance and inductance of simple geometric arrangements.

Personal Competence:
Social Competence:
Students are able to solve specific problems alone or in a group and to present the results accordingly. Students can explain concepts and on the basis of examples verify and deepen their understanding.
Autonomy:
Students are able to acquire particular knowledge using textbook in a self-learning process, to integrate, present and associate this knowledge with other fields. The students develop perseverance to also solve more complicated problems.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 110, Study Time in Lecture: 70

Assignment for the Following Curricula:
General Engineering Science (English program): Kernqualifikation: Compulsory

Course: Electrical Engineering I (Vorlesung)

Lecturer:
Prof. Manfred Kasper

Language:
EN

Cycle:
WS

Content:

1. Basics of Resistive Circuits
2. Simplifying Resistive Circuits
3. Network Analysis
4. The Electrostatic Field
5. Stationary Currents in Conductive Media

6. Electrostatic Field in Non-Conductive Media
7. Static Magnetic Field
8. Induction and Time-Dependent Fields

Literature:

1. M. Kasper, Lecture Notes Electrical Engineering Fundamentals 1, 2013
2. A. R. Hambley: Electrical Engineering, Principles and Applications, Pearson Education, 2008
3. P. M. Fishbane: Physics for Scientists and Engineers, Prentice Hall, 1996
4. M. Albach: Grundlagen der Elektrotechnik 1, Pearson Education, 2004
5. F. Moeller, H. Frohne, K.H. Löcherer, H. Müller: Grundlagen der Elektrotechnik, Teubner, 2005

Course: Electrical Engineering I (Übung)

Lecturer:
Prof. Manfred Kasper

Language:
EN

Cycle:
WS

Content:

1. Basics of Resistive Circuits
2. Simplifying Resistive Circuits
3. Network Analysis
4. The Electrostatic Field
5. Stationary Currents in Conductive Media
6. Electrostatic Field in Non-Conductive Media
7. Static Magnetic Field
8. Induction and Time-Dependent Fields

Literature:

1. M. Kasper, Lecture Notes Electrical Engineering Fundamentals 1, 2013
2. A. R. Hambley: Electrical Engineering, Principles and Applications, Pearson Education, 2008
3. P. M. Fishbane: Physics for Scientists and Engineers, Prentice Hall, 1996
4. M. Albach: Grundlagen der Elektrotechnik 1, Pearson Education, 2004
5. F. Moeller, H. Frohne, K.H. Löcherer, H. Müller: Grundlagen der Elektrotechnik, Teubner, 2005

Module: Mechanics I (GES)

Courses:

Title	Typ	Hrs/wk
Mechanics I (GES)	Vorlesung	2
Mechanics I (GES)	Hörsaalübung	3

Module Responsibility:
Prof. Radoslaw Iwankiewicz

Admission Requirements:

Recommended Previous Knowledge:

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The primary purpose of the study of Statics is to develop the capacity to predict the effects of forces on rigid bodies, structural elements and simple structures, which are at rest (in equilibrium). Such a capacity is critical to the design of many structural or engineering systems. The particular objectives of this course are to:

1. Introduce the student to the basic principles required to analyse the effects of forces applied to rigid bodies, structural elements and simple structures in equilibrium;
2. Demonstrate sound techniques of constructing and solving idealised mathematical models of real engineering systems;
3. Promote the analytical and problem-solving skills required to solve a wide variety of real engineering problems effectively.

Capabilities:
At the end of this course the student is able to:

1. Apply the properties of two- and three-dimensional force systems to the analysis of structural elements and simple structures in equilibrium.
2. Isolate a body in equilibrium by drawing its free-body diagram on which all forces acting on the body are represented.
3. Analyse the external effects of forces acting on a single body or a system of bodies in two- and three-dimensional equilibrium using the free-body diagram of the body or system.
4. Analyse the internal forces in trusses and beams.
5. Solve problems of equilibrium with account for dry friction.
6. Determine mass centres and centroids of lines, areas and volumes.

Personal Competence:
Social Competence:
Students can: - work in groups and report on the findings, - develop joint solutions in mixed teams and present them to others, - assess the team collaboration and their own share in it.
Autonomy:
Students are able to: - solve the problems independently with the help of hints, - assess their own strengths and weaknesses, e.g. with the aid of the mid-term test.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 110, Study Time in Lecture: 70

Assignment for the Following Curricula:
General Engineering Science (English program): Kernqualifikation: Compulsory

Course: Mechanics I (GES) (Vorlesung)

Lecturer:
Prof. Radoslaw Iwankiewicz

Language:
EN

Cycle:
WS

Content:

1. Two-dimensional (2D) force systems.: moment of a force about a point, reduction of a system of forces, resultant.
2. Three-dimensional (3D) force systems; moment of a force about a point and about an axis, reduction of a system of forces, resultant, wrench.

3. Supports and bearings, constraints, reactive forces, mechanical system isolation, free-body diagram. Systems with complete and incomplete fixity.
4. Equilibrium in two and three dimensions. Equations of equilibrium.
5. Plane trusses: forces in members, the method of joints and the method of sections. Space trusses.
6. Simple structures: frames and machines.
7. Mass centers and centroids of lines, areas and volumes.
8. Friction: dry friction, types of friction problems.
9. Beams: internal effects- internal forces. Internal forces in curved-in-plane members.
10. * Flexible cables.
11. * Virtual work principle.

* Denotes an additional topic.

Literature:

1. J.L. Meriam and L.G, Kraige, Engineering Mechanics, Vol. 1, Statics, John Wiley & Sons, SI Version, 4th Edition.
2. R.C. Hibbeler, Engineering Mechanics, Statics, Pearson, Prentice Hall, SI, 3rd Edition.

Course: Mechanics I (GES) (Übung)

Lecturer:
Prof. Radoslaw Iwankiewicz

Language:
EN

Cycle:
WS

Content:

1. Two-dimensional (2D) force systems.: moment of a force about a point, reduction of a system of forces, resultant.
2. Three-dimensional (3D) force systems; moment of a force about a point and about an axis, reduction of a system of forces, resultant, wrench.
3. Supports and bearings, constraints, reactive forces, mechanical system isolation, free-body diagram. Systems with complete and incomplete fixity.
4. Equilibrium in two and three dimensions. Equations of equilibrium.
5. Plane trusses: forces in members, the method of joints and the method of sections. Space trusses.
6. Simple structures: frames and machines.
7. Mass centers and centroids of lines, areas and volumes.
8. Friction: dry friction, types of friction problems.
9. Beams: internal effects- internal forces. Internal forces in curved-in-plane members.
10. * Flexible cables.
11. * Virtual work principle.

* Denotes an additional topic.

Literature:

1. J.L. Meriam and L.G, Kraige, Engineering Mechanics, Vol. 1, Statics, John Wiley & Sons, SI Version, 4th Edition.
2. R.C. Hibbeler, Engineering Mechanics, Statics, Pearson, Prentice Hall, SI, 3rd Edition.

Module: Physics for Engineers (GES)

Courses:

Title	Typ	Hrs/wk
Physics for Engineers (GES)	Vorlesung	2
Physics for Engineers (GES)	Gruppenübung	1
Physics-Lab for ET/IIW-Engineers	Laborpraktikum	1

Module Responsibility:
Dr. Alexander Petrov

Admission Requirements:
Highschool Diploma

Recommended Previous Knowledge:

- Calculus and linear algebra on high school level
- Physics on high school level

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students can explain fundamental topics and laws of physics such as in the areas of mechanics, oscillations, waves, and optics.
Students can relate physics topics to technical problems.
Capabilities:
Students can describe physical problems mathematically and solve such problems within the framework of their acquired mathematical expertise.
Students are able to write meaningful reports on experiments and to discuss the results in a conclusive way.

Personal Competence:
Social Competence:
Students can jointly solve subject related problems in groups. They can present their results effectively within the framework of the problem solving and lab courses.
Autonomy:
Students are capable to extract relevant information from the provided references and to relate this information to the content of the lecture.
They can reflect their acquired level of expertise with the help of lecture accompanying measures such as exam typical exam questions.
Students are able to connect their knowledge with that acquired from other lectures.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
General Engineering Science (English program): Kernqualifikation: Compulsory

Course: Physics for Engineers (GES) (Vorlesung)

Lecturer:
Dr. Alexander Petrov

Language:
EN

Cycle:
WS

Content:

- Introduction
- Kinematics and dynamics
- Work, Energy, momentum
- Rotatory Motion, moments of inertia
- Gravitation
- Special Theory of Relativity
- Oscillations
- Waves
- Geometrical optics

- Wave optics
- Matter waves
- Fundamentals of quantum mechanics

Literature:

- D. Halliday, R. Resnick and J. Walker ("HRW-7"), Fundamentals of Physics – Extended Edition, 7th ed., (Wiley 2005); available in the TUHH Library 'Lehrbuchsammlung'.
- K. Cummings, P. Laws, E. Redish, and P. Cooney ("CLRC"), Understanding Physics, (Wiley 2004); available in the TUHH Library 'Lehrbuchsammlung'.
- Other books that cover similar topics are, e.g., Physics by Fishbane, Gasiorowicz and Thornton and Physics by Tipler and Mosca.

Course: Physics for Engineers (GES) (Übung)

Lecturer:
Dr. Alexander Petrov

Language:
EN

Cycle:
WS

Content:

- Introduction
- Kinematics and dynamics
- Work, Energy, momentum
- Rotatory Motion, moments of inertia
- Gravitation
- Special Theory of Relativity
- Oscillations
- Waves
- Geometrical optics
- Wave optics
- Matter waves
- Fundamentals of quantum mechanics

Literature:

- D. Halliday, R. Resnick and J. Walker ("HRW-7"), Fundamentals of Physics – Extended Edition, 7th ed., (Wiley 2005); available in the TUHH Library 'Lehrbuchsammlung'.
- K. Cummings, P. Laws, E. Redish, and P. Cooney ("CLRC"), Understanding Physics, (Wiley 2004); available in the TUHH Library 'Lehrbuchsammlung'.
- Other books that cover similar topics are, e.g., Physics by Fishbane, Gasiorowicz and Thornton and Physics by Tipler and Mosca.

Course: Physics-Lab for ET/IIW-Engineers (Laborpraktikum)

Lecturer:
Prof. Wolfgang Hansen

Language:
DE/EN

Cycle:
SS

Content:
In the physics lab a number of key experiments on physical phenomena in mechanics, oscillatory and wave motion, thermodynamics, electricity, and optics will be conducted by the students under assistance of a lecturing tutor. The experiments are part of the physics education program presented in the course "Physics for TUHH-ET Engineers".
Beyond teaching of fundamental physical background the objectives are basic skills in preparation and performing physical measurements, usage of physical equipment, analysis of the results and preparation of a report on the experimental data.

Literature:
Zu den Versuchen gibt es individuelle Versuchsanleitungen, die vor der Versuchsdurchführung ausgegeben werden.
Zum Teil müssen die zur Versuchsdurchführung notwendigen physikalischen Hintergründe selbstständig erarbeitet werden, wozu die zur Vorlesung "Physik für TUHH-ET Ingenieure" angegebene Literatur gut geeignet ist.

Module: Fundamentals of Mechanical Engineering Design

Courses:

Title	Typ	Hrs/wk
Fundamentals of Mechanical Engineering Design	Vorlesung	2
Fundamentals of Mechanical Engineering Design	Hörsaalübung	2

Module Responsibility:
Prof. Dieter Krause

Admission Requirements:
None

Recommended Previous Knowledge:

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
After passing the module, students are able to:

- explain basic working principles and functions of machine elements,
- explain requirements, selection criteria, application scenarios and practical examples of basic machine elements, indicate the background of dimensioning calculations.

Capabilities:
After passing the module, students are able to:

- accomplish dimensioning calculations of covered machine elements,
- transfer knowledge learned in the module to new requirements and tasks (problem solving skills),
- recognize the content of technical drawings and schematic sketches,
- technically evaluate basic designs.

Personal Competence:
Social Competence:

- Students are able to discuss technical information in the lecture supported by activating methods.

Autonomy:

- Students are able to independently deepen their acquired knowledge in exercises.
- Students are able to acquire additional knowledge and to recapitulate poorly understood content e.g. by using the video recordings of the lectures.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
General Engineering Science (German program): Kernqualifikation: Compulsory
Energy and Environmental Engineering: Kernqualifikation: Compulsory
General Engineering Science (English program): Kernqualifikation: Compulsory
Logistics and Mobility: Kernqualifikation: Compulsory
Mechanical Engineering: Kernqualifikation: Compulsory
Mechatronics: Kernqualifikation: Compulsory
Naval Architecture: Kernqualifikation: Compulsory
Technomathematics: Kernqualifikation: Compulsory suffrage

Course: Fundamentals of Mechanical Engineering Design (Vorlesung)

Lecturer:
Prof. Dieter Krause, Prof. Josef Schlattmann, Prof. Otto von Estorff

Language:
DE

Cycle:
SS

Content:

Lecture

- Introduction to design
- Introduction to the following machine elements
  - Screws
  - Shaft-hub joints
  - Rolling contact bearings
  - Welding / adhesive / solder joints
  - Springs
  - Axes & shafts

- Presentation of technical objects, creation of production documentations (technical drawing)

Exercise

- Calculation methods for dimensioning the following machine elements:
  - Screws
  - Shaft-hub joints
  - Rolling contact bearings
  - Welding / adhesive / solder joints
  - Springs
  - Axis & shafts

Literature:

- Dubbel, Taschenbuch für den Maschinenbau; Grote, K.-H., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.
- Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.
- Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.
- Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.
- Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.
- Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.
- Maschinenelemente – Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.
- Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.
- Sowie weitere Bücher zu speziellen Themen

Course: Fundamentals of Mechanical Engineering Design (Übung)

Lecturer:
Prof. Dieter Krause, Prof. Josef Schlattmann, Prof. Otto von Estorff

Language:
DE

Cycle:
SS

Content:
Lecture

- Introduction to design
- Introduction to the following machine elements
  - Screws
  - Shaft-hub joints
  - Rolling contact bearings
  - Welding / adhesive / solder joints
  - Springs
  - Axes & shafts

- Presentation of technical objects, creation of production documentations (technical drawing)

Exercise

- Calculation methods for dimensioning the following machine elements:
  - Screws
  - Shaft-hub joints
  - Rolling contact bearings
  - Welding / adhesive / solder joints

- Springs
- Axis & shafts

Literature:

- Dubbel, Taschenbuch für den Maschinenbau; Grote, K.-H., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.
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- Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.
- Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.
- Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.
- Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.
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- Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.
- Sowie weitere Bücher zu speziellen Themen

Module: Technical Thermodynamics I

Courses:

Title	Typ	Hrs/wk
Technical Thermodynamics I	Vorlesung	2
Technical Thermodynamics I	Hörsaalübung	1
Technical Thermodynamics I	Gruppenübung	1

Module Responsibility:
Prof. Gerhard Schmitz

Admission Requirements:
none

Recommended Previous Knowledge:
Elementary knowledge in Mathematics and Mechanics

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students are familiar with the laws of Thermodynamic. They know the relation of the kinds of energy according to 1st law of Thermodynamic and are aware about the limits of energy conversions according to 2nd law of Thermodynamic. They are able to distinguish between state variables and process variables and know the meaning of different state variables like temperature, enthalpy, entropy and also the meaning of exergy and anergy. They are able to draw the Carnot cycle in a Thermodynamic related diagram. They know the physical difference between an ideal and a real gas and are able to use the related equations of state. They know the meaning of a fundamental state of equation and know the basics of two phase Thermodynamic.

Capabilities:
Students are able to calculate the internal energy, the enthalpy, the kinetic and the potential energy as well as work and heat for simple change of states and to use this calculations for the Carnot cycle. They are able to calculate state variables for an ideal and for a real gas from measured thermal state variables.

Personal Competence:
Social Competence:
The students are able to discuss in small groups and develop an approach.
Autonomy:
Students are able to define independently tasks, to get new knowledge from existing knowledge as well as to find ways to use the knowledge in practice.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
General Engineering Science (German program): Kernqualifikation: Compulsory
Bioprocess Engineering: Kernqualifikation: Compulsory
Energy and Environmental Engineering: Kernqualifikation: Compulsory
General Engineering Science (English program): Kernqualifikation: Compulsory
Computational Science and Engineering: Vertiefung Engineering Sciences: Compulsory suffrage
Mechanical Engineering: Kernqualifikation: Compulsory
Mechatronics: Kernqualifikation: Compulsory
Naval Architecture: Kernqualifikation: Compulsory
Technomathematics: Vertiefung Engineering Science: Compulsory suffrage
Process Engineering: Kernqualifikation: Compulsory

Course: Technical Thermodynamics I (Vorlesung)

Lecturer:
Prof. Gerhard Schmitz

Language:
DE

Cycle:
SS

Content:

1. Introduction
2. Fundamental terms
3. Thermal Equilibrium and temperature
   3.1 Thermal equation of state
4. First law
   4.1 Heat and work
   4.2 First law for closed systems
   4.3 First law for open systems
   4.4 Examples
5. Equations of state and changes of state
   5.1 Changes of state
   5.2 Cycle processes
6. Second law
   6.1 Carnot process
   6.2 Entropy
   6.3 Examples
   6.4 Exergy
7. Thermodynamic properties of pure fluids
   7.1 Fundamental equations of Thermodynamics
   7.2 Thermodynamic potentials
   7.3 Calorific state variables for arbitrary fluids
   7.4 state equations (van der Waals u.a.)

Literature:

- Schmitz, G.: Technische Thermodynamik, TuTech Verlag, Hamburg, 2009
- Baehr, H.D.; Kabelac, S.: Thermodynamik, 15. Auflage, Springer Verlag, Berlin 2012
- Potter, M.; Somerton, C.: Thermodynamics for Engineers, Mc GrawHill, 1993

Course: Technical Thermodynamics I (Übung)

Lecturer:
Prof. Gerhard Schmitz

Language:
DE

Cycle:
SS

Content:

1. Introduction
2. Fundamental terms
3. Thermal Equilibrium and temperature
   3.1 Thermal equation of state
4. First law
   4.1 Heat and work
   4.2 First law for closed systems
   4.3 First law for open systems
   4.4 Examples
5. Equations of state and changes of state
   5.1 Changes of state
   5.2 Cycle processes
6. Second law
   6.1 Carnot process
   6.2 Entropy
   6.3 Examples
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- Potter, M.; Somerton, C.: Thermodynamics for Engineers, Mc GrawHill, 1993

Course: Technical Thermodynamics I (Übung)

Lecturer:
Prof. Gerhard Schmitz

Language:
DE

Cycle:
SS

Content:

1. Introduction
2. Fundamental terms
3. Thermal Equilibrium and temperature
   3.1 Thermal equation of state
4. First law
   4.1 Heat and work
   4.2 First law for closed systems
   4.3 First law for open systems
   4.4 Examples
5. Equations of state and changes of state
   5.1 Changes of state
   5.2 Cycle processes
6. Second law
   6.1 Carnot process
   6.2 Entropy
   6.3 Examples
   6.4 Exergy
7. Thermodynamic properties of pure fluids
   7.1 Fundamental equations of Thermodynamics
   7.2 Thermodynamic potentials
   7.3 Calorific state variables for arbitrary fluids
   7.4 state equations (van der Waals u.a.)

Literature:

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- Baehr, H.D.; Kabelac, S.: Thermodynamik, 15. Auflage, Springer Verlag, Berlin 2012
- Potter, M.; Somerton, C.: Thermodynamics for Engineers, Mc GrawHill, 1993

Module: Mathematical Analysis

Courses:

Title	Typ	Hrs/wk
Mathematical Analysis	Vorlesung	4
Mathematical Analysis	Hörsaalübung	2
Mathematical Analysis	Gruppenübung	2

Module Responsibility:
NN

Admission Requirements:

Recommended Previous Knowledge:

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:

- Students can name the basic concepts in analysis. They are able to explain them using appropriate examples.
- Students can discuss logical connections between these concepts. They are capable of illustrating these connections with the help of examples.
- They know proof strategies and can reproduce them.

Capabilities:

- Students can model problems in analysis with the help of the concepts studied in this course. Moreover, they are capable of solving them by applying established methods.
- Students are able to discover and verify further logical connections between the concepts studied in the course.
- For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results.

Personal Competence:
Social Competence:
Autonomy:

ECTS-Credit points:
8 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 128, Study Time in Lecture: 112

Assignment for the Following Curricula:
Computer Science: Kernqualifikation: Compulsory
General Engineering Science (English program): Kernqualifikation: Compulsory

Course: Mathematical Analysis (Vorlesung)

Lecturer:
NN

Language:
EN

Cycle:
SS

Content:
Convergence, sequences, and series
Continuity
Elementary functions
Differential calculus
Integral calculus
Sequences of functions

Literature:
Königsberger: Analysis
Forster: Analysis

Course: Mathematical Analysis (Übung)

Lecturer:
NN

Language:
EN

Cycle:
SS

Content:
Convergence, sequences, and series
Continuity
Elementary functions
Differential calculus
Integral calculus
Sequences of functions

Literature:
Königsberger: Analysis
Forster: Analysis

Course: Mathematical Analysis (Übung)

Lecturer:
NN

Language:
EN

Cycle:
SS

Content:
Convergence, sequences, and series
Continuity
Elementary functions
Differential calculus
Integral calculus
Sequences of functions

Literature:
Königsberger: Analysis
Forster: Analysis

Module: Electrical Engineering II

Courses:

Title	Typ	Hrs/wk
Electrical Engineering II	Vorlesung	3
Electrical Engineering II	Gruppenübung	2

Module Responsibility:
Prof. Frank Gronwald

Admission Requirements:
None

Recommended Previous Knowledge:
Content of the Lecture "Electrical Engineering I (Elektrotechnik I)"

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students know the basic theory, relations and methods of time dependent network theory and basic nonlinear circuit elements. This includes, in particular:

- transients,
- the use of complex numbers and phasors,
- the concept of impedance,
- steady state sinusoidal circuit analysis,
- complex power and 3-phase systems,
- transformers,
- transfer function and filters,
- the concept of resonance,
- diodes and rectifiers,
- bipolar transistors and operational amplifiers

Capabilities:
The students are able to establish relations between time dependent currents and voltages in linear networks. The students know how to apply network theory to analyze 3-phase systems, transformers, filter-like structures, and resonating networks. The students know to include basic nonlinear circuit elements, such as diodes, bipolar transistors, and operational amplifiers, into the network analysis.

Personal Competence:
Social Competence:
Students are able to solve specific problems, alone or in a group, and to present the results accordingly. Students can explain concepts and, on the basis of examples and exercises, verify and deepen their understanding.
Autonomy:
Students are able to acquire particular knowledge using textbooks in a self-learning process, to integrate, present, and associate this knowledge with other fields. The students develop persistency to also solve more complicated problems.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 110, Study Time in Lecture: 70

Assignment for the Following Curricula:
General Engineering Science (English program): Kernqualifikation: Compulsory

Course: Electrical Engineering II (Vorlesung)

Lecturer:
Prof. Frank Gronwald

Language:
EN

Cycle:
SS

Content:

- Transients
- Periodic and sinusoidal signals
- Power in AC circuits

- Three-phase systems
- Transformers
- Harmonic analysis, transfer functions, filters, locus curve, and Bode plot
- Resonant circuits
- Diodes and nonlinear circuits
- Bipolar transistor and operational amplifier

Literature:

- A.R. Hambley: "Electrical Engineering", 5th ed., (Pearson, 2011)
- M. Albach: "Elektrotechnik", (Pearson, 2011).

Course: Electrical Engineering II (Übung)

Lecturer:
Prof. Frank Gronwald

Language:
EN

Cycle:
SS

Content:
The exercise sessions serve to deepen the understanding of the concepts of the lecture.

Literature:

- A.R. Hambley: "Electrical Engineering", 5th ed., (Pearson, 2011)
- M. Albach: "Elektrotechnik", (Pearson, 2011).

Module: Mechanics II (GES)

Courses:

Title	Typ	Hrs/wk
Mechanics II (GES)	Vorlesung	2
Mechanics II (GES)	Hörsaalübung	2

Module Responsibility:
Prof. Radoslaw Iwankiewicz

Admission Requirements:

Recommended Previous Knowledge:

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The primary purpose of the study of Mechanics of Materials/Solids is to develop the capacity to predict the effects of forces on elastic bodies, structural elements and simple structures, which are at rest (in equilibrium). Such a capacity is critical to the design of many structural or engineering systems. The particular objectives of this course are to:

1. Introduce the student to the basic principles required to analyse the effects of forces applied to elastic bodies, structural elements and simple structures in equilibrium;
2. Demonstrate sound techniques of constructing and solving idealised mathematical models of real engineering systems;
3. Promote the analytical and problem-solving skills required to solve a wide variety of real engineering problems effectively.

Capabilities:
At the end of this course the student should be able to:

1. Determine average normal and shear stresses.
2. Determine shear stresses and the angle of twist due to torsion of a circular shaft.
3. Determine thermal stresses in rods.
4. Analyse statically indeterminate rods and shafts..
5. Determine area moments of inertia as well as principal axes and moments of inertia.
6. Determine normal and shear stresses as well as deflections due to bending.
7. Analyse plane state of stress (stress transformation).
8. Analyse stability of equilibrium of simple systems and buckling of elastic columns.
9. Determine displacements and solve statically indeterminate problems with the aid of energy (Castigliano's) method.

Personal Competence:
Social Competence:
Students can: -work in groups and report on the findings, - develop joint solutions in mixed teams and present them to others, - assess the team collaboration and their own share in it.
Autonomy:
Students are able to; - solve the problems independently with the help of hints, - assess their own strengths and weaknesses, e.g. with the help of the mid-term test.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
General Engineering Science (English program): Kernqualifikation: Compulsory

Course: Mechanics II (GES) (Vorlesung)

Lecturer:
Prof. Radoslaw Iwankiewicz

Language:
EN

Cycle:

SS

Content:

COURSE CONTENTS:

1. Normal and shear stress, average normal and shear stress.
2. Normal and shear strain.
3. Axial loading: elastic deformation and statically indeterminate problems. Thermal stresses. Statically indeterminate axially loaded rods.
4. Area moments of inertia.
5. Torsion of a circular shaft: shear strain and stress, the angle of twist.
6. Bending. Pure and symmetric bending: normal strain and stress. Deflection of beams: elastic curve. Statically indeterminate beams.
7. Un-symmetric bending.
8. Bending with a transverse shear: shear stresses in beams. Shear flow in thin-walled members, shear center.
9. Plane-stress transformation.
10. Stability of equilibrium and buckling of elastic columns.
11. Elastic strain energy and energy methods: Castigliano's theorem – determination of displacements and statically indeterminate problems.
12. *Membrane theory of rotational shells: thin-walled pressure vessels.*

(*) denotes an additional topic.

Literature:

1. R.C. Hibbeler, Mechanics of Materials, Pearson, Prentice Hall, SI 2nd Edition
2. R.C. Hibbeler, Engineering Mechanics, Statics, Pearson, Prentice Hall, SI 3rd Edition
3. J.L. Meriam and L.G, Kraige, Engineering Mechanics, Vol. 1, Statics, John Wiley & Sons, SI Version, 4th Edition

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Course: Mechanics II (GES) (Übung)

Lecturer:

Prof. Radoslaw Iwankiewicz

Language:

EN

Cycle:

SS

Content:

COURSE CONTENTS:

1. Normal and shear stress, average normal and shear stress.
2. Normal and shear strain.
3. Axial loading: elastic deformation and statically indeterminate problems. Thermal stresses. Statically indeterminate axially loaded rods.
4. Area moments of inertia.
5. Torsion of a circular shaft: shear strain and stress, the angle of twist.
6. Bending. Pure and symmetric bending: normal strain and stress. Deflection of beams: elastic curve. Statically indeterminate beams.
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8. Bending with a transverse shear: shear stresses in beams. Shear flow in thin-walled members, shear center.
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12. *Membrane theory of rotational shells: thin-walled pressure vessels.*

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2. R.C. Hibbeler, Engineering Mechanics, Statics, Pearson, Prentice Hall, SI 3rd Edition
3. J.L. Meriam and L.G, Kraige, Engineering Mechanics, Vol. 1, Statics, John Wiley & Sons, SI Version, 4th Edition

Module: Programming in C

Courses:

Title	Typ	Hrs/wk
Programming in C	Vorlesung	1
Programming in C	Laborpraktikum	1

Module Responsibility:
Prof. Siegfried Rump

Admission Requirements:
None

Recommended Previous Knowledge:
Elementary PC handling skills
Elementary mathematical skills

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students know by heart the basic syntax of C programming as well as its meaning, intent and purpose.
They know the fundamental components and principles of elementary procedural programming based on C programming and can explain them:
• basic data types (integers, floating point numbers, characters)
• advanced data types (pointers, arrays, strings, composed data types, type conversion)
• operators (arithmetical operations, logical operations, bit operations)
• control flow (choice, loops, jumps, conditional compilation)
• functions and macros
• important standard libraries and functions
• recursion
• linked lists
The students are prepared for continuing programming lectures like object oriented programming in C++.
Capabilities:
The students know how to use an integrated development environment for C programming on a PC so that they can write, store, compile and execute C programs on it.
Using their knowledge they are able to read and understand given C Programs.
They can solve simple algorithmic problems on their own and can model and program their solutions in C language.
The students are able to solve selected exercises from other areas of their study like mathematics, mechanics, electrical engineering or physics with the aid of small C programs/-projects numerically.

Personal Competence:
Social Competence:
The students are able to work in small teams to solve given weekly tasks, to identify and analyze programming errors and to present their results.
They are able to explain simple phenomena to each other directly at the PC.
Autonomy:
The students prepare themselves using the given teaching material and solve the given programming exercises on their own.
Additionally, they write small C programs to understand and check addressed issues and also to gain a certain programming experience.
For details beyond the scope of the lecture the students inform themselves using the stated literature and / or by supplementary own research.

ECTS-Credit points:
2 LP

Examination:
Hausarbeit

Workload in Hours:
Indipendent Study Time: 32, Study Time in Lecture: 28

Assignment for the Following Curricula:
General Engineering Science (German program): Kernqualifikation: Compulsory
General Engineering Science (English program): Kernqualifikation: Compulsory

Course: Programming in C (Vorlesung)

Lecturer:
Prof. Siegfried Rump

Language:
DE/EN

Cycle:
SS

Content:
C-Programming:

1. basic data types (integers, floating point numbers, characters, boolean values)
2. advanced data types (pointers, arrays, strings, composed data types, type conversion)
3. operators (arithmetical operations, logical operations, bit operations)
4. control flow (choice, loops, jumps, conditional compilation)
5. functions and macros (basic function definitions and calls, program parameters, "call by value" versus "call by reference", storage classes, functions with variable many arguments, macros, inline functions, modular design, function pointers)
6. important standard libraries and functions (stdio.h, stdlib.h, math.h, string.h, ctype.h, time.h)
7. example programs for technical and mathematical applications

Literature:
Kernighan, Brian W (Ritchie, Dennis M.;)
The C programming language
ISBN: 9780131103702
Upper Saddle River, NJ [u.a.] : Prentice Hall PTR, 2009
Sedgewick, Robert
Algorithms in C
ISBN: 0201316633
Reading, Mass. [u.a.] : Addison-Wesley, 2007
Kaiser, Ulrich (Kecher, Christoph.;)
C/C++: Von den Grundlagen zur professionellen Programmierung
ISBN: 9783898428392
Bonn : Galileo Press, 2010
Wolf, Jürgen
C von A bis Z : das umfassende Handbuch
ISBN: 3836214113
Bonn : Galileo Press, 2009

Course: Programming in C (Laborpraktikum)

Lecturer:
Prof. Siegfried Rump

Language:
DE/EN

Cycle:
SS

Content:
C-Programming:

1. basic data types (integers, floating point numbers, characters, boolean values)
2. advanced data types (pointers, arrays, strings, composed data types, type conversion)
3. operators (arithmetical operations, logical operations, bit operations)
4. control flow (choice, loops, jumps, conditional compilation)
5. functions and macros (basic function definitions and calls, program parameters, "call by value" versus "call by reference", storage classes, functions with variable many arguments, macros, inline functions, modular design, function pointers)
6. important standard libraries and functions (stdio.h, stdlib.h, math.h, string.h, ctype.h, time.h)
7. example programs for technical and mathematical applications

Literature:
Kernighan, Brian W (Ritchie, Dennis M.;)
The C programming language
ISBN: 9780131103702
Upper Saddle River, NJ [u.a.] : Prentice Hall PTR, 2009
Sedgewick, Robert
Algorithms in C
ISBN: 0201316633
Reading, Mass. [u.a.] : Addison-Wesley, 2007
Kaiser, Ulrich (Kecher, Christoph.;)
C/C++: Von den Grundlagen zur professionellen Programmierung
ISBN: 9783898428392
Bonn : Galileo Press, 2010
Wolf, Jürgen
C von A bis Z : das umfassende Handbuch

ISBN: 3836214113
Bonn : Galileo Press, 2009

Module: Technical Thermodynamics II

Courses:

Title	Typ	Hrs/wk
Technical Thermodynamics II	Vorlesung	2
Technical Thermodynamics II	Hörsaalübung	1
Technical Thermodynamics II	Gruppenübung	1

Module Responsibility:
Prof. Gerhard Schmitz

Admission Requirements:
none

Recommended Previous Knowledge:
Elementary knowledge in Mathematics, Mechanics and Technical Thermodynamics I

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students are familiar with different cycle processes like Joule, Otto, Diesel, Stirling, Seiliger and Clausius-Rankine. They are able to derive energetic and exergetic efficiencies and know the influence different factors. They know the difference between anti clockwise and clockwise cycles (heat-power cycle, cooling cycle). They have increased knowledge of steam cycles and are able to draw the different cycles in Thermodynamic related diagrams. They know the laws of gas mixtures, especially of humid air processes and are able to perform simple combustion calculations. They are provided with basic knowledge in gas dynamics and know the definition of the speed of sound and know about a Laval nozzle.

Capabilities:
Students are able to use thermodynamic laws for the design of technical processes. Especially they are able to formulate energy, exergy- and entropy balances and by this to optimise technical processes. They are able to perform simple safety calculations in regard to an outflowing gas from a tank. They are able to transform a verbal formulated message into an abstract formal procedure.

Personal Competence:
Social Competence:
The students are able to discuss in small groups and develop an approach.
Autonomy:
Students are able to define independently tasks, to get new knowledge from existing knowledge as well as to find ways to use the knowledge in practice.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
General Engineering Science (German program): Kernqualifikation: Compulsory
Bioprocess Engineering: Kernqualifikation: Compulsory
Energy and Environmental Engineering: Kernqualifikation: Compulsory
General Engineering Science (English program): Kernqualifikation: Compulsory
Computational Science and Engineering: Vertiefung Engineering Sciences: Compulsory suffrage
Mechanical Engineering: Kernqualifikation: Compulsory
Mechatronics: Kernqualifikation: Compulsory
Technomathematics: Kernqualifikation: Compulsory suffrage
Process Engineering: Kernqualifikation: Compulsory

Course: Technical Thermodynamics II (Vorlesung)

Lecturer:
Prof. Gerhard Schmitz

Language:
DE

Cycle:

WS

Content:

8. Cycle processes
7. Gas - vapor - mixtures
10. Open sytems with constant flow rates
11. Combustion processes
12. Special fields of Thermodynamics

Literature:

- Schmitz, G.: Technische Thermodynamik, TuTech Verlag, Hamburg, 2009
- Baehr, H.D.; Kabelac, S.: Thermodynamik, 15. Auflage, Springer Verlag, Berlin 2012
- Potter, M.; Somerton, C.: Thermodynamics for Engineers, Mc GrawHill, 1993

Course: Technical Thermodynamics II (Übung)

Lecturer:

Prof. Gerhard Schmitz

Language:

DE

Cycle:

WS

Content:

8. Cycle processes
7. Gas - vapor - mixtures
10. Open sytems with constant flow rates
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Literature:

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Course: Technical Thermodynamics II (Übung)

Lecturer:

Prof. Gerhard Schmitz

Language:

DE

Cycle:

WS

Content:

8. Cycle processes
7. Gas - vapor - mixtures
10. Open sytems with constant flow rates
11. Combustion processes
12. Special fields of Thermodynamics

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- Schmitz, G.: Technische Thermodynamik, TuTech Verlag, Hamburg, 2009
- Baehr, H.D.; Kabelac, S.: Thermodynamik, 15. Auflage, Springer Verlag, Berlin 2012
- Potter, M.; Somerton, C.: Thermodynamics for Engineers, Mc GrawHill, 1993

Module: Computer Engineering

Courses:

Title	Typ	Hrs/wk
Computer Engineering	Vorlesung	3
Computer Engineering	Gruppenübung	1

Module Responsibility:
NN

Admission Requirements:
None

Recommended Previous Knowledge:
Basic knowledge in electrical engineering.

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Basic knowledge in digital circuit design
Capabilities:
Students are capable of analyzing and designing digital circuits.
They an choice of suitable analysis and synthesis techniques.

Personal Competence:
Social Competence:
Autonomy:

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
General Engineering Science (German program): Kernqualifikation: Compulsory
Computer Science: Kernqualifikation: Compulsory
Electrical Engineering: Kernqualifikation: Compulsory
Electrical Engineering myTrack: Kernqualifikation: Compulsory
General Engineering Science (English program): Kernqualifikation: Compulsory
Computational Science and Engineering: Kernqualifikation: Compulsory
Mechatronics: Kernqualifikation: Compulsory
Technomathematics: Vertiefung Informatics: Compulsory suffrage

Course: Computer Engineering (Vorlesung)

Lecturer:
NN

Language:
DE

Cycle:
WS

Content:

1. Introduction

- Principles of digital design
- Analog versus Digital
- Gates and flip-flops
- Aspects of digital design
- Integrated cicuits
- Digital devices
- Time-to-market

2. Number Systems and Codes

- General positional number systems
- Representation of numbers
- Binary arithmetic
- Number and character codes
- Codes for detecting and correcting errors
- Codes for serial data transmission
- Binary prefixes

3. Digital Circuits

- Logic signals and gates
- Logic families
- CMOS logic
- CMOS circuits: electrical behavior
- CMOS input and output structures
- Bipolar logic
- CMOS logic families
- CMOS/TLL interfacing

4. Combinational Logic Design (Principles)

- Switching algebra
- Combinational-circuit analysis
- Combinational-circuit synthesis
- Minimization
- Timing hazards

5. Combinational Logic Design (Practices)

- Documentation standards
- Timing of digital circuits
- Decoders and encoders
- Three-state devices
- Multiplexers and demultiplexers
- Exclusive-OR gates and parity circuits
- Comparators
- Adders and subtractors
- Combinational multiplier
- Barrel shifter
- Arithmetic and logic unit (ALU)

6. Sequential Logic Design (Principles)

- State concept and clock signal
- Bistable elements
- Asynchronous latches
- Synchronous latches
- Synchronous flip-flops
- Overview: latches and flip-flops
- Clocked synchronous state-machine analysis
- Clocked synchronous state-machine design
- Designing state machines using state diagrams
- Sequential-circuit design with VHDL
- Decomposing state machines

7. Sequential Logic Design (Practices)

- Sequential-circuit documentation standards
- Latches and flip-flops
- Counters
- Shift registers
- Iterative versus sequential circuits
- Synchronous design methodology
- Impediments to synchronous design

8. Memory, PLDs, CPLDs und FPGAs

- ROM, SRAM, DRAM, SDRAM

- Programmable logic devices (PLDs)
- Complex programmable logic devices (CPLDs)
- Field-programmable gate arrays (FPGAs)

9. Microprocessor Technology (Principles)

- Computer history
- Von Neumann architecture
- Components of a microprocessor system

Literature:

- S. Voigt, *Skript zur Vorlesung „Technische Informatik"*
- J. Wakerly, *Digital Design: Principles and Practices*, 4. Auflage, 2010, Pearson Prentice Hall, ISBN: 978-0-13-613987-4
- D. Hoffmann, *Grundlagen der Technischen Informatik*, 2. Auflage, 2010, Carl Hanser Verlag, ISBN: 978-3-446-42150-9

Course: Computer Engineering (Übung)

Lecturer:
NN

Language:
DE

Cycle:
WS

Content:

1. Introduction

- Principles of digital design
- Analog versus Digital
- Gates and flip-flops
- Aspects of digital design
- Integrated cicuits
- Digital devices
- Time-to-market

2. Number Systems and Codes

- General positional number systems
- Representation of numbers
- Binary arithmetic
- Number and character codes
- Codes for detecting and correcting errors
- Codes for serial data transmission
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- Logic families
- CMOS logic
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- CMOS input and output structures
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- CMOS/TLL interfacing

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- D. Hoffmann, *Grundlagen der Technischen Informatik*, 2. Auflage, 2010, Carl Hanser Verlag, ISBN: 978-3-446-42150-9

Courses:

Title	Typ	Hrs/wk
Analysis III	Vorlesung	2
Analysis III	Gruppenübung	1
Analysis III	Hörsaalübung	1
Differential Equations 1 (Ordinary Differential Equations)	Vorlesung	2
Differential Equations 1 (Ordinary Differential Equations)	Gruppenübung	1
Differential Equations 1 (Ordinary Differential Equations)	Hörsaalübung	1

Module Responsibility:
Prof. Anusch Taraz

Admission Requirements:
none

Recommended Previous Knowledge:
Mathematics I + II

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:

- Students can name the basic concepts in the area of analysis and differential equations. They are able to explain them using appropriate examples.
- Students can discuss logical connections between these concepts. They are capable of illustrating these connections with the help of examples.
- They know proof strategies and can reproduce them.

Capabilities:

- Students can model problems in the area of analysis and differential equations with the help of the concepts studied in this course. Moreover, they are capable of solving them by applying established methods.
- Students are able to discover and verify further logical connections between the concepts studied in the course.
- For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results.

Personal Competence:
Social Competence:

- Students are able to work together in teams. They are capable to use mathematics as a common language.
- In doing so, they can communicate new concepts according to the needs of their cooperating partners. Moreover, they can design examples to check and deepen the understanding of their peers.

Autonomy:

- Students are capable of checking their understanding of complex concepts on their own. They can specify open questions precisely and know where to get help in solving them.
- Students have developed sufficient persistence to be able to work for longer periods in a goal-oriented manner on hard problems.

ECTS-Credit points:
8 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 128, Study Time in Lecture: 112

Assignment for the Following Curricula:
General Engineering Science (German program): Kernqualifikation: Compulsory
Bioprocess Engineering: Kernqualifikation: Compulsory
Computer Science: Kernqualifikation: Compulsory
Electrical Engineering: Kernqualifikation: Compulsory
Electrical Engineering myTrack: Kernqualifikation: Compulsory
Energy and Environmental Engineering: Kernqualifikation: Compulsory

General Engineering Science (English program): Kernqualifikation: Compulsory
Computational Science and Engineering: Kernqualifikation: Compulsory
Mechanical Engineering: Kernqualifikation: Compulsory
Mechatronics: Kernqualifikation: Compulsory
Naval Architecture: Kernqualifikation: Compulsory
Process Engineering: Kernqualifikation: Compulsory

Course: Analysis III (Vorlesung)

Lecturer:
Dozenten des Fachbereiches Mathematik der UHH

Language:
DE

Cycle:
WS

Content:
Main features of differential and integrational calculus of several variables

- Differential calculus for several variables
- Mean value theorems and Taylor's theorem
- Maximum and minimum values
- Implicit functions
- Minimization under equality constraints
- Newton's method for multiple variables
- Double integrals over general regions
- Line and surface integrals
- Theorems of Gauß and Stokes

Literature:

- R. Ansorge, H. J. Oberle: Mathematik für Ingenieure, Band 2; Verlag Wiley-VCH, Berlin, Weinheim, New York, 2000
- H.J. Oberle, K. Rothe, Th. Sonar: Mathematik für Ingenieure, Band 3: Aufgaben und Lösungen; Verlag Wiley-VCH, Berlin, Weinheim, New York, 2000.

Course: Analysis III (Übung)

Lecturer:
Dozenten des Fachbereiches Mathematik der UHH

Language:
DE

Cycle:
WS

Content:
Main features of differential and integrational calculus of several variables

- Differential calculus for several variables
- Mean value theorems and Taylor's theorem
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Course: Analysis III (Übung)

Lecturer:
Dozenten des Fachbereiches Mathematik der UHH

Language:
DE

Cycle:

WS

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Course: Differential Equations 1 (Ordinary Differential Equations) (Vorlesung)

Lecturer:

Dozenten des Fachbereiches Mathematik der UHH

Language:

DE

Cycle:

WS

Content:

Main features of the theory and numerical treatment of ordinary differential equations

- Introduction and elementary methods
- Exsitence and uniqueness of initial value problems
- Linear differential equations
- Stability and qualitative behaviour of the solution
- Boundary value problems and basic concepts of calculus of variations
- Eigenvalue problems
- Numerical methods for the integration of initial and boundary value problems
- Classification of partial differential equations

Literature:

- R. Ansorge, H. J. Oberle: Mathematik für Ingenieure, Band 2; Verlag Wiley-VCH, Berlin, Weinheim, New York, 2000
- H.J. Oberle, K. Rothe, Th. Sonar: Mathematik für Ingenieure, Band 3: Aufgaben und Lösungen; Verlag Wiley-VCH, Berlin, Weinheim, New York, 2000.

Course: Differential Equations 1 (Ordinary Differential Equations) (Übung)

Lecturer:

Dozenten des Fachbereiches Mathematik der UHH

Language:

DE

Cycle:

WS

Content:

Main features of the theory and numerical treatment of ordinary differential equations

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Course: Differential Equations 1 (Ordinary Differential Equations) (Übung)

Lecturer:
Dozenten des Fachbereiches Mathematik der UHH

Language:
DE

Cycle:
WS

Content:
Main features of the theory and numerical treatment of ordinary differential equations

- Introduction and elementary methods
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Module: Mechanics III (GES)

Courses:

Title	Typ	Hrs/wk
Mechanics III (GES)	Vorlesung	3
Mechanics III (GES)	Hörsaalübung	1
Mechanics III (GES)	Gruppenübung	2

Module Responsibility:
Prof. Radoslaw Iwankiewicz

Admission Requirements:

Recommended Previous Knowledge:

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The primary purpose of the study of Mechanics III (Fluid Statics, Kinematics and Kinetics) is to develop the capacity to predict the effects of forces and motions, necessary for the analysis and design of moving machine parts, different machinery, vehicles, aircraft, spacecraft, automatic control systems, etc.The particular objectives of this course are to:

1. Determine the hydrostatic forces acting on different objects.
2. Analyse stability of floating bodies.
3. Analyse the kinematics and kinetics of a particle in different reference systems,
4. Analyse the motion of the system of particles and forces acting on it,
5. Analyse the plane motion of a rigid body (simple mechanism) and forces acting on it.
6. Analyse the three-dimensional motion of a rigid body and forces acting on it.

Capabilities:
At the end of this course the student should be able to:

1. Solve the equilibrium problems with account for hydrostatic pressure forces.
2. Analyse stability of simple floating bodies.

3. Calculate the velocity and acceleration of a particle in different reference systems.

- 4. Derive and solve the equation of motion of a particle in different reference systems.

5. Analyse the motion of the system of particles and forces acting on it with the aid of work-energy and impulse-momentum relationships,
6. Calculate the instantaneous linear and angular velocities and accelerations of the planar mechanisms.
7. Derive and solve the equations of a plane motion of a rigid body and find forces acting on it,
8. Apply work-energy and impulse-momentum relationships to analyse plane kinetics of a rigid body.
9. Calculate the instantaneous linear and angular velocities and accelerations of the three-dimensional motion of a rigid body.
10. Derive the equations of a motion of a three-dimensional motion of a rigid body.
11. Apply in three-dimensional kinematics and kinetics of rigid body both methods of vector algebra and matrix methods.

Personal Competence:
Social Competence:
Students can: - work in groups and report on the findings, - develop joint solutions in mixed teams and present them to others, - assess the team collaboration and their share in it.
Autonomy:
Students are able to: -solve the problems independently with the help of hints, - assess their own strengths and weaknesses, e.g. with the aid of the mid-term test.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 96, Study Time in Lecture: 84

Assignment for the Following Curricula:
General Engineering Science (English program): Kernqualifikation: Compulsory

Course: Mechanics III (GES) (Vorlesung)

Lecturer:
Prof. Radoslaw Iwankiewicz

Language:

EN

Cycle:
WS

Content:
FLUID STATICS

1. Fluid pressure, hydrostatic pressure on flat and cylindrical surfaces.
2. Buoyancy force, buoyancy center, metacenter, stability of floating objects.

KINEMATICS

1. Kinematics of a particle. Plane curvilinear motion: rectangular coordinates, normal and tangential coordinates, polar coordinates. Space curvilinear motion.
2. Constrained motion of connected particles.
3. Plane kinematics of a rigid body.
4. Relative (compound) motion.
5. Three-dimensional kinematics of a rigid body.

KINETICS

1. Kinetics of a particle and of a system of particles.
2. Plane kinetics of a rigid body.
3. Three-dimensional kinetics of a rigid body.

Literature:
1. J.L. Meriam and L.G, Kraige, Engineering Mechanics, Vol. 2, Dynamics, John Wiley & Sons, SI Version, 4th Edition
2 . R.C. Hibbeler, Engineering Mechanics, Dynamics, Pearson, Prentice Hall, SI 3rd Edition

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Course: Mechanics III (GES) (Übung)

Lecturer:
Prof. Radoslaw Iwankiewicz

Language:
EN

Cycle:
WS

Content:
FLUID STATICS

1. Fluid pressure, hydrostatic pressure on flat and cylindrical surfaces.
2. Buoyancy force, buoyancy center, metacenter, stability of floating objects.

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4. Relative (compound) motion.
5. Three-dimensional kinematics of a rigid body.

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1. J.L. Meriam and L.G, Kraige, Engineering Mechanics, Vol. 2, Dynamics, John Wiley & Sons, SI Version, 4th Edition
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Course: Mechanics III (GES) (Übung)

Lecturer:
Prof. Radoslaw Iwankiewicz

Language:
EN

Cycle:
WS

Content:

FLUID STATICS

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Courses:

Title	Typ	Hrs/wk
Introduction to Control Systems	Vorlesung	2
Introduction to Control Systems	Gruppenübung	2

Module Responsibility:
Prof. Herbert Werner

Admission Requirements:

Recommended Previous Knowledge:
Representation of signals and systems in time and frequency domain, Laplace transform

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:

- Students can represent dynamic system behavior in time and frequency domain, and can in particular explain properties of first and second order systems
- They can explain the dynamics of simple control loops and interpret dynamic properties in terms of frequency response and root locus
- They can explain the Nyquist stability criterion and the stability margins derived from it.
- They can explain the role of the phase margin in analysis and synthesis of control loops
- They can explain the way a PID controller affects a control loop in terms of its frequency response
- They can explain issues arising when controllers designed in continuous time domain are implemented digitally

Capabilities:

- Students can transform models of linear dynamic systems from time to frequency domain and vice versa
- They can simulate and assess the behavior of systems and control loops
- They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules
- They can analyze and synthesize simple control loops with the help of root locus and frequency response techniques
- They can calculate discrete-time approximations of controllers designed in continuous-time and use it for digital implementation
- They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out these tasks

Personal Competence:
Social Competence:
Students can work in small groups to jointly solve technical problems, and experimentally validate their controller designs
Autonomy:
Students can obtain information from provided sources (lecture notes, software documentation, experiment guides) and use it when solving given problems.
They can assess their knowledge in weekly on-line tests and thereby control their learning progress.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
General Engineering Science (German program): Kernqualifikation: Compulsory
Bioprocess Engineering: Kernqualifikation: Compulsory
Computer Science: Vertiefung Computational Mathematics: Compulsory suffrage
Electrical Engineering: Kernqualifikation: Compulsory
Electrical Engineering myTrack: Kernqualifikation: Compulsory
Energy and Environmental Engineering: Kernqualifikation: Compulsory
General Engineering Science (English program): Kernqualifikation: Compulsory
Computational Science and Engineering: Kernqualifikation: Compulsory suffrage
Logistics and Mobility: Vertiefung Engineering Science: Compulsory suffrage
Mechanical Engineering: Kernqualifikation: Compulsory
Mechatronics: Kernqualifikation: Compulsory
Technomathematics: Vertiefung Engineering Science: Compulsory suffrage
Process Engineering: Kernqualifikation: Compulsory

Course: Introduction to Control Systems (Vorlesung)

Lecturer:
Prof. Herbert Werner

Language:
DE

Cycle:
WS

Content:
Signals and systems

- Linear systems, differential equations and transfer functions
- First and second order systems, poles and zeros, impulse and step response
- Stability

Feedback systems

- Principle of feedback, open-loop versus closed-loop control
- Reference tracking and disturbance rejection
- Types of feedback, PID control
- System type and steady-state error, error constants
- Internal model principle

Root locus techniques

- Root locus plots
- Root locus design of PID controllers

Frequency response techniques

- Bode diagram
- Minimum and non-minimum phase systems
- Nyquist plot, Nyquist stability criterion, phase and gain margin
- Loop shaping, lead lag compensation
- Frequency response interpretation of PID control

Time delay systems

- Root locus and frequency response of time delay systems
- Smith predictor

Digital control

- Sampled-data systems, difference equations
- Tustin approximation, digital implementation of PID controllers

Software tools

- Introduction to Matlab, Simulink, Control toolbox
- Computer-based exercises throughout the course

Literature:

- Werner, H., Lecture Notes „Introduction to Control Systems“
- G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems", Addison Wesley, Reading, MA, 2009
- K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, NJ, 2010
- R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010

Course: Introduction to Control Systems (Übung)

Lecturer:
Prof. Herbert Werner

Language:
DE

Cycle:
WS

Content:
Signals and systems

- Linear systems, differential equations and transfer functions
- First and second order systems, poles and zeros, impulse and step response
- Stability

Feedback systems

- Principle of feedback, open-loop versus closed-loop control
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- R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010

Courses:

Title	Typ	Hrs/wk
Introduction to Methods for Business Decision Making	Vorlesung	2
Production Management and Organization	Vorlesung	2
Blue Engineering – Aspects of Social and Ecological Responsibility	Seminar	2
Introduction to Law	Vorlesung	2
Introduction to Engineering Education Research	Seminar	2
European Culture: Introduction to Architecture, Style and Cultural History	Vorlesung	2
European Culture: History	Seminar	2
European Culture: Art	Seminar	2
European Culture: Literature	Seminar	2
Increasing Flexibility on the Job? Current Analyses from the Sociology of Work	Seminar	2
Foreign Language Course	Seminar	2
Humanities and Engineering: Introduction to Communication Psychology	Seminar	2
Humanities and Engineering: Ethics for Engineers	Seminar	2
Gender and Technology	Seminar	2
History of Photography	Seminar	2
History of Shipbuilding	Vorlesung	2
Business Model Innovation	Seminar	2
Business Planning	Vorlesung	2
Changing Society	Vorlesung	2
Techniques and Methods of Conversations and Negotiation	Seminar	2
Global Innovation Management	Vorlesung	2
Foundations of Organization	Vorlesung	2
Entrepreneurship	Vorlesung	2
Theory and Practice of University Teaching	Seminar	2
Illustrations as Means of Communication	Seminar	2
Analysis, structuring and graphic design of presentations	Seminar	2
Interdisziplinarity: Culture and Technology	Seminar	2
Intercultural Management and Communication	Seminar	2
Career Management	Vorlesung	2
Creativity Workshop: Improvisational Theatre	Seminar	2
Culture and Technology - in German	Seminar	2
Culture and Technology - in English	Seminar	2
Logistic Systems: Planning, Investment Decisions, Operating	Vorlesung	2
Modern History of Technology	Seminar	2
Law for Engineers	Vorlesung	2
Sociology of Engineer Profession	Seminar	2
Sociology of the Internet	Seminar	2
Technology in the Arts	Seminar	2
Technology, Management and Social Responsibility	Seminar	2
Environment and Society	Vorlesung	2
Environmental Policy	Seminar	2
Corporate Strategies	Vorlesung	2
Civil- & Business Law	Vorlesung	2
Business Ethics	Vorlesung	2

Academic Research and Writing	Seminar	2
Time Management and Self-Organisation	Seminar	2

Module Responsibility:
Dagmar Richter

Admission Requirements:
none

Recommended Previous Knowledge:
take a look at lecture descriptions

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The Non-technical Elective Study Area
imparts skills that, in view of the TUHH's training profile, professional engineering studies require but are not able to cover fully. Self-reliance, self-management, collaboration and professional and personnel management competences. The department implements these training objectives in its **teaching architecture**, in its **teaching and learning arrangements**, in **teaching areas** and by means of teaching offerings in which students can qualify by opting for **specific competences** and a **competence level** at the Bachelor's or Master's level.
The teaching offerings are pooled in two different catalogues for nontechnical complementary courses.
The Learning Architecture
consists of a cross-disciplinarily study offering. The centrally designed teaching offering ensures that courses in the "non-technical department" follow the specific profiling of TUHH degree courses.
The learning architecture demands and trains independent educational planning as regards the individual development of competences. It also provides orientation knowledge in the form of "profiles"
The subjects that can be studied in parallel throughout the student's entire study program - if need be, it can be studied in one to two semesters. In view of the adaptation problems that individuals commonly face in their first semesters after making the transition from school to university and in order to encourage individually planned semesters abroad, there is no obligation to study these subjects in one or two specific semesters during the course of studies.
Teaching and Learning Arrangements
provide for students, separated into B.Sc. and M.Sc., to learn with and from each other across semesters. The challenge of dealing with interdisciplinarity and a variety of stages of learning in courses are part of the learning architecture and are deliberately encouraged in specific courses.
Fields of Teaching
are based on research findings from the academic disciplines cultural studies, social studies, arts, historical studies, communication studies and sustainability research, and from engineering didactics. In addition, from the winter semester 2014/15 students on all Bachelor's courses will have the opportunity to learn about business management and start-ups in a goal-oriented way.
The fields of teaching are augmented by soft skills offers and a foreign language offer. Here, the focus is on encouraging goal-oriented communication skills, e.g. the skills required by outgoing engineers in international and intercultural situations.
The Competence Level
of the courses offered in this area is different as regards the basic training objective in the Bachelor's and Master's fields. These differences are reflected in the practical examples used, in content topics that refer to different professional application contexts, and in the higher scientific and theoretical level of abstraction in the B.Sc.
This is also reflected in the different quality of soft skills, which relate to the different team positions and different group leadership functions of Bachelor's and Master's graduates in their future working life.
Specialized Competence (Knowledge)
Students can

- locate selected specialized areas with the relevant non-technical mother discipline,
- outline basic theories, categories, terminology, models, concepts or artistic techniques in the disciplines represented in the learning area,
- different specialist disciplines relate to their own discipline and differentiate it as well as make connections,
- sketch the basic outlines of how scientific disciplines, paradigms, models, instruments, methods and forms of representation in the specialized sciences are subject to individual and socio-cultural interpretation and historicity,
- Can communicate in a foreign language in a manner appropriate to the subject.

Capabilities:
Professional Competence (Skills)
In selected sub-areas students can

- apply basic methods of the said scientific disciplines,
- auestion a specific technical phenomena, models, theories from the viewpoint of another, aforementioned specialist discipline,
- to handle simple questions in aforementioned scientific disciplines in a sucsessful manner,
- justify their decisions on forms of organization and application in practical questions in contexts that go beyond the technical relationship to the subject.

Personal Competence:

Social Competence:

Personal Competences (Social Skills)

Students will be able

- to learn to collaborate in different manner,
- to present and analyze problems in the abovementioned fields in a partner or group situation in a manner appropriate to the addressees,
- to express themselves competently, in a culturally appropriate and gender-sensitive manner in the language of the country (as far as this study-focus would be chosen),
- to explain nontechnical items to auditorium with technical background knowledge.

Autonomy:

Personal Competences (Self-reliance)

Students are able in selected areas

- to reflect on their own profession and professionalism in the context of real-life fields of application
- to organize themselves and their own learning processes
- to reflect and decide questions in front of a broad education background
- to communicate a nontechnical item in a competent way in writen form or verbaly
- to organize themselves as an entrepreneurial subject country (as far as this study-focus would be chosen)

ECTS-Credit points:

6 LP

Examination:

Workload in Hours:

Indipendent Study Time: 96, Study Time in Lecture: 84

Assignment for the Following Curricula:

General Engineering Science (German program): Kernqualifikation: Compulsory
Civil- and Environmental Engeneering: Kernqualifikation: Compulsory
Bioprocess Engineering: Kernqualifikation: Compulsory
Computer Science: Kernqualifikation: Compulsory
Electrical Engineering: Kernqualifikation: Compulsory
Electrical Engineering myTrack: Kernqualifikation: Compulsory
Energy and Environmental Engineering: Kernqualifikation: Compulsory
General Engineering Science (English program): Kernqualifikation: Compulsory
Computational Science and Engineering: Kernqualifikation: Compulsory
Logistics and Mobility: Kernqualifikation: Compulsory
Mechanical Engineering: Kernqualifikation: Compulsory
Mechatronics: Kernqualifikation: Compulsory
Naval Architecture: Kernqualifikation: Compulsory
Technomathematics: Kernqualifikation: Compulsory
Process Engineering: Kernqualifikation: Compulsory

Course: Introduction to Methods for Business Decision Making (Vorlesung)

Lecturer:

Dr. Ines Krebs-Zerdick

Language:

DE

Cycle:

SS

Content:

Recommended Previous Knowledge:
Modules BWL I and BWL II
Contents:

1. Problem analysis, structuring and formulation
2. Planning analyses & Generating data
3. Solving problems: Analysis and decision
   - Decisions under singular and multiple objectives
   - Decisions under uncertainty and risk
4. Bounded rationality and psychological traps
5. Implementing decisions
   - Communication of analyses and decisions

- Achieving sustainable impact of decisions
- The influence of a company's culture, organization and management styles on decision making processes

Learning Outcomes:
The aim of this lecture is for the students to learn how to structure and model complex decision situations, and how to analyse and solve the resulting problems. Especially, they should be able to apply the knowledge they gain to practical decision situations from the field of business and management.
In particular, after successful completion of this module, students should be able to

- Analyse and structure decision situations
- Apply structured methods for generating alternatives
- Develop and analyse goals and systems of goals
- Solve specific decision problems, as, e.g., problems with multiple objectives or probles under risk, by suitable methods
- Take into account psychological traps and their effect on decision makers

Moreover, students should be able to comment on the limitations of the different approaches and develop own ideas for solving complex problems. Students should be able to see decisions in the context of business realities and

- make a judgement on the resources required for decision making and factor them into the choice of a suitable problem solving approach
- treat implementation of decisions systematically as part of the problem solving process
- understand how decision making processes in companies can be shaped and influence business success

Literature:
Eisenführ, F., Weber, M.: Rationales Entscheiden, 5. Auflage, Springer-Verlag, Berlin et al. 2010.
Weitere Literaturhinweise werden in der Veranstaltung gegeben./ Further current bibliography will be given in lecture.
will be given in lecture.

Course: Production Management and Organization (Vorlesung)

Lecturer:
Prof. Hermann Lödding

Language:
DE

Cycle:
WS

Content:

1. Leadership
2. Communication
3. Management of the key performance indicators
4. Methods
5. Strategies

Literature:

- Vorlesungsskript

Course: Blue Engineering – Aspects of Social and Ecological Responsibility (Seminar)

Lecturer:
Christian Hoffmann

Language:
DE

Cycle:
WS/SS

Content:
The seminar broaches the connection and the contrast between both ecological and social responsibility associated with engineering as the central theme. The underlying vision is a socially and ecologically sustainable form of technology, which makes an attempt at an holistic approach to problem solving. In that particular sense, a creative take on questions regarding sustainability and the development of preliminary solutions is emphasized. Examples for topics dealt with during the seminar exist in the multiple dimensions of sustainability requirements, ethics in technology, alternative business and economic models and particular instances of promising trends in technology or – possibly constrasting – non-technical approaches.

Literature:
Literature will be handed out at the beginning of the seminar.

Literature:
Abhängig von den jeweiligen Gruppenthemen einer Seminarinstanz. Die Literatur wird zu Beginn des Seminars ausgegeben./ Selected

current bibliography will be given in lecture.

Course: Introduction to Law (Vorlesung)

Lecturer:
Klaus Tempke

Language:
DE

Cycle:
WS

Content:
Recommended Prior Knowledge / Requirements:
Students are required to have their own copy of the "Bürgerliches Gesetzbuch (BGB)" for lectures and written exam
Discussion Topics:
Discussion of jurisdictions with different stages of appeal and members of the courts, mainly in the area of civil law;
Difference between a statement of claim, default summon and writ of execution in adjective law;
Different levels of legal capacity (full and restricted) as well the determination of criminal ability;
Development of a contract and discussion of different types of contracts;
Implications of challenges and representations in conclusions of a contracU
Contract extensions, statutory limitations and the implications of an event of default.
Learning targets:
Introduction to "legal thinking" and gathering a basic understanding of the different stages of a court process.
Key aspects of a contract, including representations, implications of defaults, extensions and statutory limitations.
Required Reading:
Supplemental materials will be provided during lectures (other than BGB copy above)

Literature:
Begleitende Unterrichtsmaterialien werden verteilt. / Current bibliography will be given in lecture.

Course: Introduction to Engineering Education Research (Seminar)

Lecturer:
Prof. Christian Hans Gerhard Kautz

Language:
DE

Cycle:
WS/SS

Content:

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Learning scenarios, active learning methods
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Methods, results and implications of engineering education research
Conceptual understanding and misconceptions in introductory engineering courses

Research on learning behaviour, motivation, and beliefs
Preparation of Tutorials for selected lecture courses
Problem-Based Learning
Learning styles in engineering education
Assessment

Literature:
ausgewählte Artikel aus Fachzeitschriften werden an die Seminarteilnehmer verteilt, weiterführende Literatur wird zum jeweiligen Thema angegeben

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Course: European Culture: Introduction to Architecture, Style and Cultural History (Vorlesung)

Lecturer:
Prof. Margarete Jarchow

Language:

DE

Cycle:
WS

Content:
The lecture provides an overview of the different architectural styles and of art and cultural history from the Ancient World to the 20th century (Greek and Roman Antiquity, Romanesque, Gothic, Renaissance, Baroque, Rococo, Classicism, Historicism, Jugendstil, New Objectivity, New Building / Bauhaus). Stylistic epochs are illustrated by means of German and international examples.

Literature:
Wilfried Koch, Baustilkunde, Bertelsmann Lexikon Verlag, Gütersloh 1993
Jacques Tullier, Geschichte der Kunst, Architektur, Skulptur, Malerei, Paris 2002
Silvio Vietta, Europäische Kulturgeschichte – eine Einführung, München 2005

Course: European Culture: History (Seminar)

Lecturer:
Dr. Katja Iken

Language:
DE

Cycle:
WS/SS

Content:
The past influences our present life, our (collective) perception, and the way we think and act. The subject of the seminar are individual epochs of European history or selected aspects, such as the history of ideas, technological change, social and political structures. Fundamental sources of the subject matter are analyzed. By discussing source material and research findings students are made aware of how different factors (sociocultural structures, political framework conditions, technological developments) affect and influence historical processes. Societal preconditions, circumstances and consequences of historical developments are discussed.

Literature:

- Wolfgang König (Hg.): Prophyläen Technikgeschichte, Bde. 3-5, Berlin 1997.
- Handbuch der Geschichte Europas, Bd. 1-10, hrsg. von Peter Blickle (UTB)
- Gebhardt, Handbuch der deutschen Geschichte, 23. Bde (Klett-Cotta)

Course: European Culture: Art (Seminar)

Lecturer:
Dr. Gabriele Himmelmann

Language:
DE

Cycle:
WS/SS

Content:
The seminar provides an overview of art epochs. It presents forms and motifs of the visual arts, focusing especially on art in its changing functions.
Starting with the religious art of the Middle Ages, it goes on to deal with the new pictorial conception of the Renaissance. Artists overcame medieval pictorial forms and develop a new portrayal of perspective that remains a hallmark of the way we see things to this day. That was when new, secular topics found their way into art. This process continued in the Baroque era. Characterized by national and, especially, denominational identity, a large number of highly independent pictorial ideas took shape. The 18th century was characterized mainly by the Enlightenment and ended with the French Revolution. It was an age of far-reaching change in contents of consciousness, culminating for the time being in the 19th century. Existing world views changed emphatically, as was reflected especially in the art of the 20th century, for which the experience of two world wars was formative. A final look is taken at trends in art since the 1960s and until the present day.
The seminar focuses mainly on painting, sculpture, arts and crafts, and design. Individual works of art are used as examples to discuss their origins, their production conditions, their production techniques, and the societal framework conditions in which they took shape.
The course includes excursions to museums and art museums to gain access to the customary ways in which museums present their exhibits.

Literature:
- Geschichte der Kunst in 12 Bänden, Beck'sche Reihe, München 2011
- Geschichte der bildenden Kunst in Deutschland, 8 Bände, München: Prestel 2006-
- Kunst-Epochen, Reclam-Universalbibliothek, Stuttgart 2002-
- Hans Belting / Heinrich Dilly / Wolfgang Kemp / Willibald Sauerländer / Martin Warnke, Kunstgeschichte – Eine Einführung, 7. Aufl. Berlin 2008
- Jutta Held / Norbert Schneider, Grundzüge der Kunstwissenschaft, Köln 2007

- Michael J. Gelb, How to think like Leonardo da Vinci, New York 1998
- E.H. Gombrich, The Story of Art, Phaidon Press Limited, London 1995
- Wilfried Koch, Baustilkunde, Bertelsmann Lexikon Verlag, Gütersloh 1993
- Jacques Tullier, Geschichte der Kunst, Architektur, Skulptur, Malerei, Paris 2002
- Silvio Vietta, Europäische Kulturgeschichte – eine Einführung, München 2005

Course: European Culture: Literature (Seminar)

Lecturer:
Dr. Ingo Irsigler

Language:
DE

Cycle:
WS/SS

Content:
Literary texts are a mirror of the epoch in which they are written. They depend on the political, social and cultural discourse of their day and on the societal environment and esthetic ideas of their surroundings. In the literary seminar of the European Culture block we examine international literature by means of selected focal points that vary from semester to semester. They can be a specific literary era, an overview of the epochs of world literature, a specific writer or a literary genre (such as a travelogue, a novel or a drama).
Based on selected short, literary and journalistic texts, reports and film examples each seminar topic is analyzed. Especially the course focuses the aspect of "literature and media" as well as the role of technology in literature, film and journalistic works.

Literature:
- The Cambridge History of German Literature, edited by Helen Watanabe-O'Kelly, Cambridge University Press 2000
- Nicholas Boyle, German Literature, A very short introduction, Oxford University Press 2008

Course: Increasing Flexibility on the Job? Current Analyses from the Sociology of Work (Seminar)

Lecturer:
Prof. Gabriele Winker

Language:
DE

Cycle:
SS

Content:
The lecture course presents recent findings from work research concerning fundamental processes of change. Subjects include subjectification, the dissolution of boundaries, the increasingly precarious nature of work, and the reconciliation of professional and family work.

Literature:
- Deutschmann, Christoph: Postindustrielle Industriesoziologie. Theoretische Grundlagen, Arbeitsverhältnisse und soziale Identitäten. Weinheim, München, 2002
- Mikl-Horke, Gertraude: Industrie- und Arbeitssoziologie. 5., vollst. neubearb Aufl., München, Wien, 2000
- Minssen, Heiner: Arbeits- und Industriesoziologie. Eine Einführung. Franfurt, New York, 2006
- Voß, G. Günter; Pongratz, Hans J.: Der Arbeitskraftunternehmer. Eine neue Grundform der "Ware Arbeitskraft"? In: Kölner Zeitschrift für Soziologie und Sozialpsychologie, Jg. 50, 1998, H. 1, S. 131-158

Course: Foreign Language Course (Seminar)

Lecturer:
Dagmar Richter

Language:

Cycle:
WS/SS

Content:
In the Field of the Nontechnical Complementary Courses students are able to chose foreign language courses. Therefore the Hamburger Volkshochschule offers a special language programm on TUHH campus for TUHH Students. It includes courses in english, chinese, french, japanese, portuguese, russia, swedish, spanisch and german as a foreign language. All lectures impart common language knowledge, english courses although english for technical purposes.

Literature:
Kursspezifische Literatur / selected bibliography depending on special lecture programm.

Course: Humanities and Engineering: Introduction to Communication Psychology (Seminar)

Lecturer:
Ronja Liebnau

Language:
DE

Cycle:
WS/SS

Content:
The seminar conveys insights into contents and methods of communication psychology and the uses to which it can be put in engineering. The main emphasis is on the Schulz von Thun models of Hamburg communication psychology, such as the Communication Square, the Inner Team, and the Square of Values and Development. They are taught and applied to specific engineering situations and to communicational challenges encountered in everyday working life.
In addition, the seminar deals with transactional analysis and conversational skills, among which methods such as active listening play a key part.
Along with presentations (group work) by the students, practical exercises are mainly used, incorporating students' career issues and experiences. Working in small groups, the models are demonstrated in this way and in-depth understanding of them is obtained by means of communication examples of their own.

Literature:
Lück, Helmut E. (2011) Geschichte der Psychologie; Strömungen, Schulen, Entwicklungen; Grundriss der Psychologie Bd. 1. Kohlhammer.
Brüggemeier, Beate (2010). Wertschätzende Kommunikation im Business: Wer sich öffnet, kommt weiter. Wie Sie die Gewaltfreie Kommunikation im Berufsalltag nutzen. Junfermann.
Watzlawick, Paul, Beavin, Janet H. & Jackson, Don D. (2011). Menschliche Kommunikation: Formen, Störungen, Paradoxien. Huber.
Schmidt, Rainer (2009). Immer richtig miteinander reden: Transaktionsanalyse in Beruf und Alltag. Junfermann.
Schulz von Thun, Friedemann (2010). Miteinander reden 1: Störungen und Klärungen. Allgemeine Psychologie der Kommunikation. Rororo.
Schulz von Thun, Friedemann (2010). Miteinander reden, Band 3: Das "Innere Team" und situationsgerechte Kommunikation. Rororo. Schwerpunkte: Kapitel 1, 3, 6
Schulz von Thun, Friedemann (2010). Miteinander reden 2: Stile, Werte und Persönlichkeitsentwicklung; Differentielle Psychologie der Kommunikation. Rororo.
Helwig, Paul (1969). Charakterologie. Herder. S. 63-69
Stahl, Eberhard (2002). Dynamik in Gruppen. Handbuch der Gruppenleitung. Beltz.
Fisher, Roger, Ury, William& Patton, Bruce (2009). Das Harvard-Konzept: Der Klassiker der Verhandlungstechnik. Campus.
Simon, Walter (2004). GABALs großer Methodenkoffer: Grundlagen der Kommunikation. Verhandlungstechniken. GABAL. S. 205 – 213

Course: Humanities and Engineering: Ethics for Engineers (Seminar)

Lecturer:
Anne Katrin Finger, Gunnar Jeremias

Language:
EN

Cycle:
WS/SS

Content:
Scientists increasingly need to acknowledge the social dimension of their work. In order to take responsibility for the political, economic, environmental and security consequences of scientific work, engineers and scientists need ethical guidelines. The seminar will address this dimension of scientific work. It will be an opportunity to discover ethics as a means to act effectively, efficiently and responsibly as an engineer and a scientist.
The goals of the seminar include:

- Raising awareness about ethical dilemmas in scientific decision-making;
- Increasing knowledge about the dual-use character of the natural sciences; and
- Improving the understanding of scientists' responsibility for the results of their professional activities.

Topics to be addressed include the role of engineers and scientists in:

- Making decisions about the distribution of rare goods;
- Preventing the misuse of technologies for hostile purposes;
- Choosing arguments and defending positions in situations of conflicting interests;
- Taking decisions at the national and international level about laws, rules and regulations concerning scientific conduct; and
- The development of codes of conduct as a guideline for responsible behaviour.

The seminar will demonstrate ethical problems in the natural sciences and engineering by looking at current problems from areas such as medicine, the life sciences and physics. Issues will include organ donation, the future of energy and the dual use problem in biological research. Seminar participants will also get an opportunity to discuss the careers of famous scientists as examples of ethical and non-

ethical behaviour.
Issues will be introduced by a short presentation and a Q & A session, followed by group work on selected problems. All participants will have to prepare a presentation. Those requiring a graded certificate additionally have to write a 3-4 page paper on selected issues. The seminar will use interactive tools of teaching such as role playing, simulations and presentations by students. Group work and active participation is expected at all stages.

Literature:

- Zilinskas, Raymond (ed.): The Microbiologist and Biological Defense Research. Ethics, Politics, and International Security, The New York Academy of Sciences, New York 1992.
- Seltzer, Jennifer (ed.): Science, Technology, and Ethical Priorities, Student Pugwash USA, Washington 1997.
- Bloemers, Wolf: Ethics and Social Justice, Frankfurt am Main 2003

Course: Gender and Technology (Seminar)

Lecturer:
Prof. Gabriele Winker

Language:
DE

Cycle:
SS

Content:
Technologies, on one hand, are socially formed and, on the other hand, influence the structures of society. Thus, gender relations also have an influence on the development and use of technologies, and are in turn influenced by technologies themselves. This course examines the exact nature of these co-constructions of gender and technology in theory and practice. The common issue is how the changes accompanying the technologies influence the gender-hierarchical division of labour, stereotypes of masculinity and femininity and the individual behaviour of women and men. We will also ask which perspectives arise from this question for a gender-sensitive design of technology.

Literature:

Frank, Susanne (2011): Neue Perspektiven in der Stadt- und Geschlechterforschung. In: Stadt und Urbanität. Transdisziplinäre Perspektiven. Berlin, 89-103.
Haraway, Donna (1995): Lieber Kyborg als Göttin. In: Monströse Versprechen. Hamburg, 165-184.
Hausen, Karin (1977): Die Polarisierung der Geschlechtercharaktere Eine Spiegelung der Dissoziation von Erwerbs- und Familienleben. In: Conze, Werner (Hg.), Sozialgeschichte der Familie in der Neuzeit Europas. Stuttgart, 363-393.
Ihsen, Susanne (2010): Ingenieurinnen: Frauen in einer Männerdomäne. In: Becker, Ruth/ Kortendiek, Beate (Hg.): Handbuch Frauen- und Geschlechterforschung. Wiesbaden, 799-805.
Parikh, Jyoti (2012): Das Mainstreaming von Gender in der Klimawandeldebatte. In: Çaglar, Gülay/Schwenken, Helen/Castro Varela, Maria do Mar (Hg.): Macht Geschlecht Klima. Feministische Perspektiven auf Klima, gesellschaftliche Naturverhältnisse und Gerechtigkeit. Opladen, 79-94.
Zachmann, Karin (2004): Die bürgerliche und soldatische Erbschaft Das Berufsbild der Ingenieure und seine Verankerung in der Geschlechterordnung (1850-1950). In: Dies.: Mobilisierung der Frauen. Frankfurt/ New York, 117-153.

Course: History of Photography (Seminar)

Lecturer:
Dr. Wolf Jahn

Language:
DE

Cycle:
WS

Content:
The seminar will provide an overview of the history of photography. One main focus will be on the interactions between new image production and traditional fine arts. Photography is also taking over non-artistic fields. It is used as a means of scientific development, as a medium for documenting travel, war or reportage and generally as the leading media image supply technology so far. In parallel, photography is developing and being transformed from analog to digital and now an omnipresent image medium.

Literature:
Wird auf Wunsch zur Verfügung gestellt; will be given on demand

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Course: History of Shipbuilding (Vorlesung)

Lecturer:
Prof. Eike Lehmann

Language:
DE

Cycle:
WS

Content:
Lecture on Historical Development of Shipbuilding
The lecture deals with the historical development of the industrial shipbuilding from the 19th century to the present time. The most important steps of the development as the adoption of steel and mechanical propulsion technique will be discussed by means of the different type of vessels. For example the development of propulsors like paddle wheels, screws and jet devices will be treated. Also the developing of the manufacture of casting, riveting and welding is to be explained.
Special topics like docking of ships or icebreaking technique or the entering of natural and engineering sciences into the naval architecture should show that shipbuilding is a very concise example of the whole industrial technique and had given in some cases the essential impuse.

Literature:
Literatur wird in der Veranstaltung bekannt gegeben.
Current biblography will be announced in lecture.

Course: Business Model Innovation (Seminar)

Lecturer:
Prof. Christoph Ihl

Language:
DE

Cycle:
SS

Content:
In companies innovation should no longer be confined to products, but must take a holistic perspective on business models. Many examples from the retail, media, but also manufacturing industries show the problems of established companies to adapt their business models. Startups are often faster and more agile in responding to business opportunities, by transforming or newly designing value offerings with service and software components.
This course aims to develop a toolkit that can be used both in established and startup companies for a systematic approach to business model innovation, so that is does not remains a coincidence. On this basis, students should form teams to design their own business model innovations.

Literature:

- Osterwalder, A.; Yves, P. (2010). Business model generation: a handbook for visionaries, game changers, and challengers. John Wiley & Sons, 2010.
- Grichnik, Dietmar; Oliver Gassmann. Das unternehmerische Unternehmen - Revitalisieren und Gestalten der Zukunft mit Effectuation - Navigieren und Kurshalten in stürmischen Zeiten. Springer, 2013.
- Gassmann, Oliver, Karolin Frankenberger, and Michaela Csik. Geschäftsmodelle entwickeln: 55 innovative Konzepte mit dem St. Galler Business Model Navigator. Carl Hanser Verlag, 2013.

Course: Business Planning (Vorlesung)

Lecturer:
Prof. Christoph Ihl

Language:
DE

Cycle:
SS

Content:
This course builds on the course "Business Model Innovation". Students should elaborate the concept for their business model innovation towards a detailed and thorough business plan. To prepare students, design, components are designing a business plan discussed and transmitted to their own business idea. In addition, students follow the principles of "evidence-based entrepreneurship" in order to explicitly formulate and test the assumptions about their business model. This validation process and its results should also be reflected in the business plans. At the end of the course, the teams are given the opportunity to present their business plans to a panel of experts.

Literature:
Blank, Steven Gary, and Bob Dorf. The startup owner's manual: the step-by-step guide for building a great company. K&S Ranch, Incorporated, 2012.
Nagl, Anna. Der Businessplan: Geschäftspläne professionell erstellen; mit Checklisten und Fallbeispielen. 6. Aufl. Wiesbaden: Gabler, 2011.

Course: Changing Society (Vorlesung)

Lecturer:
Dr. Michael Florian

Language:
DE

Cycle:
WS

Content:
The lecture focuses on different dimensions of social change in modern societies. Important problems of stability and change will be discussed, for example, globalization, relations between technology and society, demographic change, trends in the area of gender and family as well as social change of educational opportunities, poverty and social inequalities.

Literature:
Geißler, Rainer (2008): Die Sozialstruktur Deutschlands. Zur gesellschaftlichen Entwicklung mit einer Bilanz zur Vereinigung. Mit einem Beitrag von Thomas Meyer. 5., durchgesehene Auflage. Wiesbaden: VS Verlag für Sozialwissenschaften.
Giddens, Anthony; Fleck, Christian; Egger de Campo, Marianne (2009): Soziologie. Graz/Wien: Nausner & Nausner.
Jäger, Wieland; Weinzierl, Ulrike (2011): Moderne soziologische Theorien und sozialer Wandel. 2. Auflage. VS Verlag für Sozialwissenschaften und Springer Fachmedien.
Joas, Hans (Hg.) (2007): Lehrbuch der Soziologie. 3., überarbeitete und erweiterte Auflage. Frankfurt/New York: Campus Verlag.
Peuckert, Rüdiger (2012): Familienformen im sozialen Wandel. Wiesbaden: VS Verlag für Sozialwissenschaften.
Schäfers, Bernhard (2004): Sozialstruktur und sozialer Wandel in Deutschland. 8., völlig neu bearb. Aufl. Stuttgart : Lucius & Lucius.
Scheuch, Erwin K. unter Mitarb. von Ute Scheuch (2003): Sozialer Wandel. 2 Bände. Wiesbaden : Westdeutscher Verlag.
Wiswede, Günter; Kutsch, Thomas (1978): Sozialer Wandel. Zur Erklärungskraft neuerer Entwicklungs- und Modernisierungstheorien. Darmstadt: Wissenschaftliche Buchgesellschaft.
Zapf, Wolfgang (Hg.) (1979): Theorien des sozialen Wandels. 4. Aufl. Königstein/Ts.: Verl.-Gruppe Athenäum, Hain, Scriptor, Hanstein.

Course: Techniques and Methods of Conversations and Negotiation (Seminar)

Lecturer:
Sybille Hausburg

Language:
DE

Cycle:
WS/SS

Content:

- The students get views into the communication research and learn techniques of preparation, design and analysis of conversations.
- We deal with methods of argumentation and fundamentals of conflict management.
- On the basic of the Harvard concept the conditions of fair negotiations and special techniques in difficult situations are presented.
- The skills are tested by practical examples.

Literature:
Cerwinka, Gabriele u.a.: Beim ersten Eindruck gewinnen. Professionell agieren in Alltag und Business,
Linde 2006
Edmüller, Andreas u.a.; Konfliktmanagement, Haufe 2010
Fisher, Roger; William Ury; Bruce Patton: Das Harvardkonzept. Campus 2009
Heeper, Astrid; Michael Schmidt: Verhandlungstechniken, Pocket Business Cornelsen 2003
Levine, Robert: Die große Verführung. Psychologie der Manipulation, Piper Verlag 2011
Nöllke, Mathias: Schlagfertigkeit, Haufe 2009
Portner, Jutta: Besser verhandeln, Gabal Verlag 2013
Schranner, Mathias: Verhandeln im Grenzbereich, Econ Verlag 2012
Seifert, Josef W.: Visualisieren, Präsentieren, Moderieren Gabal 2009
Weisbach, Christian-Rainer: Professionelle Gesprächsführung, Beck-Wirtschaftsberater im DTV 2003

Course: Global Innovation Management (Vorlesung)

Lecturer:
Dr. Stephan Buse

Language:
EN

Cycle:
WS

Content:

General Aim:
The aim of this course is to demonstrate the challenges and opportunities offered by well differentiated innovation management within firms in view of the increasing globalisation of the world economy.
Specifiv (Learning) Obejectives:

- Why do managers have to think about “Global Innovation Management”?

- What are the characteristics and drivers of globalisation and how do they affect firms’ innovation strategies?
- What opportunities and risks do firms of different sizes face as a result of the increasing globalisation of the world economy?
- What strategic and organisational challenges concerning innovation management do firms face if they are to be able to succeed internationally?
- What can firms learn from globally successful innovators?
- What role do (global) innovation networks play? How can firms of all sizes benefit from them

Syllabus:

- Differences between “Innovation Management” and “Global Innovation Management” – An Introduction

- Drivers, Challenges and Chances of Globalisation
- Knowledge Creation Around the Globe
- Global Innovation Management in Firms
- Strategies for Extending the Global Product and Target Market Portfolio

Literature:

- R.A. Burgelman, M.A. Maidique, S.C. Wheelwright; Strategic Management of Technology and Innovation; 5th edition, Irwin, 2009.
- J. Tidd, J. bessant; Managing Innovation, 4th edition, John Wiley & Sons. Ltd., 2009.
- C.K. Prahalad, M.S. Krishnan; The new age of innovation, McGraw-Hill, 2008.
- Keith Goffin, Rick Mitchell; Innovation Management, Palgrave Macmillian, 2005.
- C.A. Bartlett, S. Ghoshal, J. Birkinshaw; Transnational Management, 4th edition, McGraw-Hill, 2004
- R. Boutellier, O. Gassmann, M. von Zedtwitz; Managing Global Innovation, Springer, 2000.
- Additional articles will be announced in class.

Course: Foundations of Organization (Vorlesung)

Lecturer:
Prof. Christian Ringle

Language:
DE

Cycle:
WS

Content:
- The Study of Organizations
- Organizational Structure and Design
- The Processes of Organizations (Design, Analysis, Optimization)
- Basics of Supply Chain Management

Literature:
Recommended Literature:
- Jones, G. R. (2010): Organizational Theory, Design, and Change, 6/e.
- Gibson, J.L./Ivancevich, J.M./Donnelly, J.H./Konopaske, R. (2009): Organizations – Behavior, Structure, Processes, 13/e.
- Slack, N./Chambers, S./Johnston, R.(2004): Operations Management, 4/e.
Further reading:
- Becker, J./Kugeler, M./Rosemann, M. (2005): Prozessmanagement: Ein Leitfaden zur prozessorientierten Organisationsgestaltung, 5. Auflage.
- Jones, G.R./Bouncken, R. (2008): Organisation: Theorie, Design und Wandel, 5. Auflage.
- Hansmann, K.-W. (2006): Industrielles Management, 8. Auflage.
- Thonemann, U. (2010): Operations Management: Konzepte, Methoden und Anwendungen, 2. Auflage.
- Voigt, K.-I. (2008): Industrielles Management – Industriebetriebslehre aus prozessorientierter Sicht.

Course: Entrepreneurship (Vorlesung)

Lecturer:
Prof. Christian Lüthje

Language:
DE

Cycle:
SS

Content:

General description of course content and course goals

The course aims at preparing students for a potential career as an entrepreneur. It starts with theoretical foundations of entrepreneurship and the impact of new ventures on innovation, technological progress and economic development. In the following sessions on business planning, students learn which strategic entrepreneurial decisions have to be made by entrepreneurs. They get to know how to develop and evaluate business ideas and business models, how to write a business plan, and how to obtain financing. Additionally, the course includes lessons about managing the new venture in the post-formation phase (especially on marketing and organizational development). The course content is based on recent results of entrepreneurship research, real-life examples, and also includes guest lectures from entrepreneurial practice.

Summarizing the most important contents

The course provides answers to the following fundamental questions of entrepreneurship theory and practice:

- Which constituent elements define an entrepreneur?
- Which specific personality traits and behaviors are attributed to entrepreneurs?
- How can we describe and structure the new venture formation process?
- What are critical success factors of entrepreneurs and what are potential barriers to success?
- What are the latest developments of entrepreneurship in Germany, the economic meaning of new ventures, and the role of political and educational support and funding?
- How can we develop and evaluate business ideas and business models?
- Which strategic decisions have to be made by entrepreneurs in the business planning process (regarding law and taxation, market analysis, growth strategies, location, networks, and strategic partnerships)?
- What makes a good business plan and how to obtain new venture financing?
- How to manage the new venture in the post-formation phase (leadership, entrepreneurial team, marketing, and organizational development)?

Knowledge

Students can...

- Understand what an entrepreneur is and which economic impact entrepreneurship has.
- Define fundamental terms and explain important theories in entrepreneurship research.
- Analyze key decisions in important areas of entrepreneurship and new venture management (e.g. financing, marketing, team formation).
- Evaluate business ideas, business models, and business plans.
- Make connections between different entrepreneurial areas of decision making in the pre- and post-foundation phase of a new venture and analyze potential reciprocal effects.

Skills

Students are capable of...

- Simultaneously considering multiple factors and taking reasoned actions in entrepreneurial decision-making (Idea generation and evaluation, business planning, financing, law and taxation, market analysis, growth strategies, location, networks, and strategic partnerships).
- Making well-grounded decisions regarding main functional business areas in realistic entrepreneurial situations (marketing, leadership, organization, entrepreneurial team, organizational development).

Social Competence

Students can...

- Provide appropriate feedback and handle feedback on their own performance constructively.
- Enter into a dialogue with formerly unknown fellow students, participate in discussions, and present well-grounded arguments.
- Constructively interact with guest speakers and learn from their practical experiences.

Self-Reliance

Students are able to...

- Evaluate consequences of a potential career as entrepreneur and state pros and cons of being an entrepreneur.
- Specify own strengths and weaknesses with regard to general entrepreneurial tasks in the new venture process.
- Justify and make decisions in entrepreneurial situations with the help from teachers as well as define tasks and acquire relevant knowledge.

Literature:

Kuratko, Donald F. (2009): Introduction to Entrepreneurship, 8th Edition, Cengage Learning
Kuratko, Donald F. and Hodgetts, Richard M. (2007): Entrepreneurship – Theory, Process Practice, Thomson South-Western
Fueglistaller, Urs; Müller, Christoph; Müller, Susan und Volery, Thierry (2012): Entrepreneurship
Modelle - Umsetzung - Perspektiven Mit Fallbeispielen aus Deutschland, Österreich und der Schweiz, Gabler

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Course: Theory and Practice of University Teaching (Seminar)

Lecturer:

Prof. Christian Hans Gerhard Kautz, Jenny Alice Rohde, Siska Simon

Language:

DE

Cycle:
WS/SS

Content:
The role of teachers and learners
Learning processes and learning theories
„Neurodidactics“, motivation, „didactic reduction“
Presentation and discussion techniques
Tools for increasing motivation and participation of students
Planning, executing and reflecting of/on a sample instructional unit
Rules and methods for feedback
Selected topics from engineering education research (methods, results, implications for teaching)
Micro teaching
peer hospitation

Literature:
Auszüge aus Fachliteratur zu oben genannten Themen werden in der Veranstaltung ausgegeben.

Course: Illustrations as Means of Communication (Seminar)

Lecturer:
Jörg Heuser

Language:
DE

Cycle:
WS

Content:
Content:
Hand-sketched illustrations are a suitable mean of communication, comparable with written descriptions, technical drawings and CAD models. In comparison illustrations can be carried out in relatively short time and do not require more tools, than just a pencil or a ball-pen. This kind of hand sketches are helpful at the beginning of a product or process development process to illustrate ideas (which are abstract by then) in an understandable and comparable matter.
The seminar teaches basic and advanced skills to perform hand-sketches. Theoretical parts will be the design and use of perspectives, drop and body shadows and other forms to create spatial impressions.
Focus is put on fast to learn technics and on utilization for daily industrial practice. The seminar exists of six parts of each three hours. Content of each part is a introduction of specific methods followed by tutorials. Students have the opportunity to present a paper to their colleagues during the last part of the seminar.
For examination students will prepare sketched solutions for a given problem statement. Exam will be a on-site test.

Literature:
Koos Eisen und Roselien Steur "Sketching - Drawing Techniques for Product Designer", BIS Verlag
Scott Robertson, "LIFT OFF - Air Vehicle Sketches ...", Designstudio Press sowie "How to Draw: Drawing and Sketching Objects and Environments from Your Imagination"

Literature:
Koos Eisen und Roselien Steur "Sketching - Drawing Techniques for Product Designer", BIS Verlag
Scott Robertson, "LIFT OFF - Air Vehicle Sketches ...", Designstudio Press sowie "How to Draw: Drawing and Sketching Objects and Environments from Your Imagination"

Course: Analysis, structuring and graphic design of presentations (Seminar)

Lecturer:
Dorothee Schielein

Language:
DE

Cycle:
WS/SS

Content:
»Knowledge becomes knowledge only through presentation and production, perception and mediumship …« (from:. »Lecture as a performance« by Sibylle Peters, Transcript Verlag Germany, 2014)
The prerequisite for a successful presentation is the precise analysis of its own content. The analysis and structure of the content is the basis for the decisions on how the presentation will be. For example: What do I want to tell to the audience? Which possibilities and methods are there for my presentation? What mood should the presentation have? (serious, motivating or funny?) etc.

In addition, the slides must be clearly legible and well designed. This graphic design requires a basic knowledge of typography, color, image design and information design that will be deepened in the seminar.
In the seminar, students are working with freely chosen themes to create a presentation. In the end of the seminar they will present their work in front of the others. We will work with the programs MS Word and / or PowerPoint. Dealing with these programs is the prerequisite.

Literature:
„Gestaltung, Typografie etc. – ein Handbuch“ Damien und Claire Gautier, Niggli Verlag

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Course: Interdisziplinarity: Culture and Technology (Seminar)

Lecturer:
Prof. Margarete Jarchow, Christian Elster

Language:
DE

Cycle:
WS/SS

Content:
Music and technology are linked very closely with each other. The technical characteristics of recording equipment, play back devices as well as communication media shape music cultures. They influence central aspects of music production, distribution and reception. The materiality and surface feel of sound carriers like LPs, CDs, MCs, digital audio files and the required play back devices affect the way we use music and are often highly symbolically charged. They are situated in a field of conflict between art, culture, technology and economy. The seminar wants to trace connections between technical developments, cultural practices and public discourses.

Literature:

- Auswahl
  -Benjamin, Walter (2000): Das Kunstwerk im Zeitalter seiner technischen Reproduzierbarkeit. Frankfurt am Main.
  -Bull, Michael (2006): Investigating the culture of mobile listening. From Walkman to iPod. In: Barry Brown und Kenton O'Hara (Hg.): Consuming Music Together.New York, S. 131–150.
  -DeNora, Tia (2000): Music in everyday life. Cambridge.
  -Gehlen, Dirk von (2011): Mash-Up. Lob der Kopie. Frankfurt am Main.
  -Hengartner, Thomas (2012): Technik – Kultur – Alltag. Technikforschung als Alltagskulturforschung. In: Schweizerisches Archiv für Volkskunde, Jg. 108, S. 117-139.
  -Wicke, Peter (2009): Der Tonträger als Medium der Musik. In: Holger Schramm (Hg.): Handbuch Musik und Medien. Konstanz: UVK-Verl.-Ges., S. 49–87.

Course: Intercultural Management and Communication (Seminar)

Lecturer:
Ernesto Martín

Language:
DE

Cycle:
WS

Content:
This course provides a sound basic knowledge of culture and "cultural dimensions" from an anthropological, national and international perspective. The course focuses on the study of the impact of intercultural factors on company policy, as well as the behaviour and success overseas.
The reinforcement of "intercultural awareness" should guide the participants to an optimisation of the communication strategies and an understanding concerning the detection of dangers and synergies within international business.
Apart from a theoretical basis of intercultural management the participants will also be confronted with practice-oriented "critical incidents", that provide an insight into the practice of international business. The course is rounded of with a reflection about self image and the image of others, and how to overcome ethnocentric attitudes.
The discussion of land specific culture in, for example, China, Spain, America and France is also an important component of the programme.

Literature:
Wird im Seminar genannt.
Will be announced in lecture.

Course: Career Management (Vorlesung)

Lecturer:
Prof. Thomas Matzen

Language:
DE

Cycle:
SS

Content:
The lecture teaches approaches of Careermanagement.
A special focus will be put on individual personality traits and there will be an in depth analysis into one of the most relevant toolkits for self-assessment.
Furthermore the following topics will be targeted:

- Preparation of one Application-documents
- Preparation for a job interview
- Basics of the underlying approaches of an assessment center

Literature:
aktuelle Literaturempfehlungen werden in der Vorlesung vermittelt
relevant literature will be announced in lecture

Course: Creativity Workshop: Improvisational Theatre (Seminar)

Lecturer:
Mignon Remé

Language:
DE

Cycle:
WS/SS

Content:
This workshop is designed to specifically train creativity, spontaneity and flexibility, as well as attentiveness, courage and fast reactions by means of improvisational theater techniques.
By overcoming the inner censor inhibitions are being diminished while at the same time the participants learn to uncover their creativity and power of imagination.
Learning how to improvise simple scenes furthermore improves the ability to communicate, therefore creating the precondition for successful coordination and cooperation within a group - i. e. team-mindedness.
By means of scene and status work they improve their performance during presentations or speeches.
The improvisation techniques address different skills of the participants in a playful way:

- The participants are asked to spontaneously react to new situations and adapt to them. This will be achieved through games and excercises which train the capacity of quick reaction and thinking on one's feet.
- New and unanticipated suggestions for scenes made by the teacher challenge the participants to a high degree of flexibility and creativity.
- By means of status work (based on Keith Johnstones teachings) the participants will be given tools to adapt their means of communication - verbal and non-verbal - to their counterpart and the situation.
- Basic acting excercises help the participants to aquire more self-confidence presenting themselves in situations like speeches and job interviews.
- Team-mindedness is being trained by almost all improvisation techniques but especially those that focus on active listening, inspiring each other and accepting offers and building on them.

Literature:
Literaturhinweise werden zu Beginn des Seminars bekanntgegeben.
Literature will be announced at the beginning of the seminar.

Course: Culture and Technology - in German (Seminar)

Lecturer:
Prof. Karl Wilhelm Böddeker

Language:
DE

Cycle:
WS

Content:

Central themes of the course are water and energy, collectively viewed as being prerequisite to the origin of life as well as to the evolution of human civilization. Water and energy are key topics of any engineering curriculum, in addition to describing the human condition as it depends on the availability and usage of either. Objectives when having to deal with water or energy differ accordingly: To optimize the technologically feasible on the one hand (technical competence); to consider social and/or ecologic constraints on the other hand (personal competence).

By discussing a number of practical case studies (see list of topics) the course aims at drawing attention to the relevance of personal competence when water or energy are to be dealt with as commodities: providing them and using them responsibly. It appears that personal competence, in addition to basic factual knowledge, requires recognition of the pertinent historical and cultural circumstances which apply, – just as cultural history cannot be amended without considering the technological advances. It appears further that most of the base materials on which our everyday existence relies came to us through life itself, beginning with oxygen as by-product of photosynthesis.

If there is a message: it seems unlikely that technical competence will pacify mankind unless modified by personal competence.

List of topics

1 Dualism: Technology and culture
2 The world in quick motion: Earth, life, man
3 Nature's smallest wonder: H_2O
4 Enough is not enough
5 Water and civilization: Ancient vs. modern Near East
6 The Dead Sea. The dilemma of environmental protection
7 Fresh water from the sea. Need activates inventiveness
8 Water: Human right or merchandise?
9 Energy as everyday commodity
10 Offer and demand: Business as usual?
11 Life's beginning and end: CO_2
12 Biography of a chemical multi-talent: Niter
13 Explosives: Beneficial and malicious

Literature:

- Brockhaus-Redaktion: Brockhaus Mensch, Natur, Technik. Vom Urknall zum Menschen. Leipzig 1999.
- Jared Diamond: Guns, Germs, and Steel. The Fates of Human Societies. Norton, New York 1999.
- Vollrath Hopp: Wasser Krise? Wiley-VCH, Weinheim 2004.
- Peter Gruss, Ferdi Schüth (Hrsg.): Die Zukunft der Energie, die Antwort der Wissenschaft. C. H. Beck, München 2008.
- Volker Quaschning: Erneuerbare Energien und Klimaschutz. Hanser, München 2008.
- Laurence C. Smith: Die Welt im Jahr 2050. Die Zukunft unserer Zivilisation. DVA, München 2011.

Course: Culture and Technology - in English (Seminar)

Lecturer:

Prof. Karl Wilhelm Böddeker

Language:

EN

Cycle:

WS

Content:

Culture and Technology (objectives)

Central themes of the course are water and energy, collectively viewed as being prerequisite to the origin of life as well as to the evolution of human civilization. Water and energy are key topics of any engineering curriculum, in addition to describing the human condition as it depends on the availability and usage of either. Objectives when having to deal with water or energy differ accordingly: To optimize the technologically feasible on the one hand (technical competence); to consider social and/or ecologic constraints on the other hand (personal competence).

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List of topics

1 Dualism: Technology and culture
2 The world in quick motion: Earth, life, man
3 Nature's smallest wonder: H_2O
4 Enough is not enough
5 Water and civilization: Ancient vs. modern Near East
6 The Dead Sea. The dilemma of environmental protection
7 Fresh water from the sea. Need activates inventiveness
8 Water: Human right or merchandise?
9 Energy as everyday commodity
10 Offer and demand: Business as usual?
11 Life's beginning and end: CO_2

12 Biography of a chemical multi-talent: Niter
13 Explosives: Beneficial and malicious

Literature:

- Brockhaus-Redaktion: Brockhaus Mensch, Natur, Technik. Vom Urknall zum Menschen. Leipzig 1999.
- Jared Diamond: Guns, Germs, and Steel. The Fates of Human Societies. Norton, New York 1999.
- Vollrath Hopp: Wasser Krise? Wiley-VCH, Weinheim 2004.
- Peter Gruss, Ferdi Schüth (Hrsg.): Die Zukunft der Energie, die Antwort der Wissenschaft. C. H. Beck, München 2008.
- Volker Quaschning: Erneuerbare Energien und Klimaschutz. Hanser, München 2008.
- Laurence C. Smith: Die Welt im Jahr 2050. Die Zukunft unserer Zivilisation. DVA, München 2011.

Course: Logistic Systems: Planning, Investment Decisions, Operating (Vorlesung)

Lecturer:
Dr. Jürgen W. Böse

Language:
DE

Cycle:
WS

Content:
Based on the concept of a “system” as defined by systems theory and classical definition approaches for the term “logistics”, the lecture starts with important organizational and technical essentials of logistics systems in the field of cargo transport, handling and storage. To facilitate the understanding, examples from numerous existing business practices are presented and the associated advantages and disadvantages of related systems are discussed.
In the following sessions, the lecture focuses on the systemic design of logistics solutions particularly highlighting planning aspects in the development phase and operations phase of logistics systems. For planning decisions regarding the type and number of system components or subsystems respectively technical details are of minor importance. In this regard, considerably more benefit is obtained from the knowledge about proven planning rules and methodological approaches. Among the quantitative methods used, against the background of system design on the above-mentioned level, analytical solutions are at the center of interest.
With the aim of prioritizing and selecting design alternatives, various evaluation methods are presented and critically discussed. The content of the lecture is especially devoted to the study of commonly used investment appraisal methods known from the field of business administration.

Literature:

- Arnold D., Furmans K. (2005): Materialfluss in Logistiksystemen, 4. Aufl., Springer, Berlin.
- Bitz M., Ewert J., Terstege U. (2012): Investition - Multimediale Einführung in finanzmathematische Entscheidungskonzepte, 2. Aufl., Gabler, Wiesbaden.
- Jünemann R. (1989): Materialfluß und Logistik, Springer, Berlin.
- Rinza P. , Schmitz H. (1992): Nutzwert-Kosten-Analyse : eine Entscheidungshilfe, VDI-Verlag, Düsseldorf.
- ten Hompel M., Schmidt T., Nagel, L. (2007): Materialflusssysteme - Förder- und Lagertechnik, 3. Aufl., Springer, Berlin.

Course: Modern History of Technology (Seminar)

Lecturer:
Prof. Hans-Joachim Braun

Language:
DE

Cycle:
SS

Content:
This seminar focuses on key issues of technological development in the 20th Century such as invention and innovation, technology transfer, communication or computer development. It also asks to what extent knowledge about recent technological developments can be useful for solving future problems.

Literature:
Wird im Seminar auf Wunsch zur Verfügung gestellt. /
Current biblography will be announced in lecture.

Course: Law for Engineers (Vorlesung)

Lecturer:
Markus A. Meyer-Chory

Language:
DE

Cycle:
WS

Content:
-basics and system of specifics of Law for Engineers
-basics of selected parts of Law for Engineers incl International Laws - i.e. laws for Construction, products, patents, trade marks, competition , labor companies
- practical case studies
-actual cases - legal evaluation

Literature:
Notwendiger Gesetztestext (in Klausur erlaubt):
Bürgerliches Gesetzbuch 72. Auflage , 2013 , dtv Beck-Texte 5001, ISBN 978-3-406-65707-8

Empfohlene Gesetzestexte:Arbeitsgesetze 83. Auflage, 2013 dtv Beck-Texte 5006 ISBN 978-3-406-65689-7
Handelsgesetzbuch 54. Auflage, 2013 dtv Beck Texte 5002 ISBN 978-3-406-65083-3
Gesellschaftsrecht, 13. Auflage , 2013 dtv Beck Texte 5585 ISBN 978-3-406-64502-0
Wettbewerbsrecht, Markenrecht und Kartellrecht , 33. Auflage, 2013 dtv Beck Texte ISBN 978-3-406-65212-7

Empfohlene Literatur:

Vock, Willi, Recht der Ingenieure, 1. Auflage 2012, Boorberg Verlag , ISBN-10:3-415-04535-8 --- EAN:9783415045354
Meurer Rechtshandbuch für Architekten und Ingenieure 1…Auflage -- erscheint Anfg 2014 Werner Verlag ISBN 978-3-8041-4342-5
Eisenberg / **Gildeggen** / **Reuter** / **Willburger** Produkthaftung 2. Auflage - erscheint Anfg 2014 Oldenbourg Verlag - ISBN 978-3-486-71324-4
ENDERS/HETGER, Grundzüge der betrieblichen Rechtsfragen, 4. Auflage, 2008 Richard Boorberg Verlag - ISBN 978-3-415-04005-2
Müssig, Peter, Wirtschaftsprivatrecht, 15. Auflage, 2012 , C.F. Müller UTB - ISBN 978-3-81149476-3
Schade, Friedrich, Wirtschaftsprivatrecht, 2. Auflage 2009, Kohlhammer - ISBN 978-3-17-021087-5

Course: Sociology of Engineer Profession (Seminar)

Lecturer:
Dr. Wolfgang Neef

Language:
DE

Cycle:
WS

Content:

- **History of Engineering Profession**
- **Role of Engineers in Society**
- **Actual Situation of Engineering Profession**
- **Sustainability: Social and ecological Responsability in Engineering Profession**
- **Subjective aspects: Gender, Personality**
- **Representation of professional Interests in enterprises**

Literature:
- Neef, Wolfgang: Ingenieure Entwicklung und Funktion einer Berufsgruppe, Köln 1982
- Neef, W. und T. Pelz (Hrsg.): Ingenieurinnen und Ingenieure für die Zukunft. Berlin, TU, 1997
- Wege und Irrwege in die Wissensgesellschaft. BDWi-Studienheft Nr. 7, Marburg 2011-08-09
- Ullrich, Otto: Weltniveau. In der Sackgasse des Industriesystems. Berlin 1992.

Course: Sociology of the Internet (Seminar)

Lecturer:
Prof. Gabriele Winker

Language:
DE

Cycle:
WS

Content:

The fact that technology is socially constructed is broadly accepted within sociology. Here, the technical design of the internet and the cultural practices of users are seen as resulting from an ongoing social process. Involved in those processes, which are conflictual (and, hence, political), are different actors from fields such as economics, politics, science and civil society. With approaches from sociology of science and technology as well as political science, the course addresses the history of the internet as well as today's social conflicts around matters like surveillance, copyright, data protection and privacy, and net neutrality.

Literature:

- Bijker, Wiebe E. ; Law, John (eds.): Shaping Technology - Building Society. Studies in Sociotechnical Change. Cambridge, London, 1992
- Döring, Nicola: Sozialpsychologie des Internet. Die Bedeutung des Internet für Kommunikationsprozesse, Identitäten, soziale Beziehungen und Gruppen. 2., vollständig überarb. und erw. Aufl., Göttingen, 2003
- Latour, Bruno: We have never been modern. 5th pr., Harlow, Essex, 2000
- Norris, Pippa: Digital Divide. Civic Engagement, Information Poverty, and the Internet Worldwide. Cambridge, 2001
- Oudshoorn, Nelly; Pinch, Trevor (eds.): How Users Matter. The Co-Construction of Users and Technologies. Cambridge, London, 2003
- Wellman, Barry; Haythornthwaite, Caroline (eds.): The Internet in Everyday Life. Oxford, 2002

Course: Technology in the Arts (Seminar)

Lecturer:
Dr. Wolf Jahn

Language:
DE

Cycle:
SS

Content:
The Art and Technology seminar deals with artists' preoccupations with technological achievements, something that stretches far back into history. How does technology enter society and how does it define the human image? These are questions that preoccupy artists to this day and that are the core of their work. Fascinated by inventions such as automats or new, high-speed modes of transport, they have had a crucial influence of the image of the arts. William Turner was the first to paint a locomotive, while Adolph Menzel was involved in painting pictures of modern industrial workers. Their pictures and works by many other artists viewed technology critically, glorified it, moved it to mythical realms or transformed it into ambivalent visions of the future. Thus art and technology does not involve delving into artistic techniques. Instead, the seminar explores how artists face up to the modern phenomenon whereby new technology plays a decisive role in defining the image of humankind and culture.

Literature:

- Horst Bredekamp: Antikensehnsucht und Maschinenglauben, Berlin 2002

Course: Technology, Management and Social Responsibility (Seminar)

Lecturer:
Dr. Torsten Meiffert

Language:
DE

Cycle:
WS

Content:
Technique, management and social responsibility
Obviously one of today's most important issues is how global society puts itself in danger by overusing natural resources. The main reasons for this self-endangerment are cross linked effects and side effects caused by the huge technological progress of the last 300 years. Its success is due to not taking into account cross linked patterns in ecological systems and - in general - to a mechanical understanding of nature.
One topic in this seminar is how the materialistic and mechanical worldview has developed since the ancient Greeks. To understand the underlying patterns of this mindset is an important prerequisite for dealing with the current ecological and economical challenges of our time.

- What are the specific success factors of the mechanical thinking?
- What approaches are already emerging for an ecological and holistic thinking?

Another topic of the seminar is how social institutions (ngo's and companies) deal with the self-endangerment of global societies. They also have to handle hyper-complexity and are not competent enough to do so.

- What are the obstacles for organizations handling complexity and self-endangerment?
- Which mindsets determine the routines in organizations? How can they be recognized and changed?
- How can companies manage the contradiction between short-term success and sustainability?

Finally we look at the context in which engineers act as specialists or managers – in terms of leadership, communication and motivation. More often the complexity of social self-endangerment is an issue of individual concern rather than of managerial and strategic thinking. Looking at the position of managers between the poles of social responsibility and economic responsibility means to deal with issues like value management and ethics.

- How can managers contribute to creating opportunities for sustainable development?
- How can managers balance conflicting interests, needs and perspectives?

Literature:

- WBGU: Welt im Wandel. Gesellschaftsvertrag für eine Große Transformation. Hauptgutachten, Berlin 2011, http://www.wbgu.de
- Beck, Ulrich: Weltrisikogesellschaft. Frankfurt/M, 2008
- Senge, Peter et al.: The Necessary Revolution. New York 2008

- Fachartikel, die zu Beginn der Veranstaltung bekannt gegeben werden./ Current biblography will be announced in lecture.

Course: Environment and Society (Vorlesung)

Lecturer:
Dr. Michael Florian

Language:
DE

Cycle:
SS

Content:
The lecturer offers an introduction to the interrelationship between environment and society from a sociological point of view. Selected issues will be discussed, e.g., empirical studies of environmental awareness, relations between awareness and behavior, trends in ecological movements, aspects of sustainable development, problems of environmental issues in business and politics as well as the analysis of opportunities to understand and influence the social impact on ecological problems.

Literature:

Brand, Karl-Werner (2014): Umweltsoziologie. Entwicklungslinien, Basiskonzepte und Erklärungsmodelle. Weinheim [u.a.]: Beltz Juventa.
Brand, Karl-Werner; Reusswig, Fritz (2007): Umwelt. In: Hans Joas (Hg.): Lehrbuch der Soziologie. 3., überarb. und erw. Aufl. 3. Aufl. Frankfurt, M, New York: Campus-Verlag, S. 653-672.
Diekmann, Andreas; Jaeger, Carlo C. (Hg.) (1996): Umweltsoziologie. Sonderheft 36/1996 der Kölner Zeitschrift für Soziologie und Sozialpsychologie. Opladen: Westdt. Verl.
Diekmann, Andreas; Preisendörfer, Peter (2001): Umweltsoziologie. Eine Einführung. Reinbek bei Hamburg: Rowohlt-Taschenbuch-Verlag.
Gross, Matthias (2001): Die Natur der Gesellschaft. Eine Geschichte der Umweltsoziologie. Weinheim: Juventa.
Groß, Matthias (Hg.) (2011): Handbuch Umweltsoziologie. Wiesbaden: VS Verlag für Sozialwissenschaften.
Huber, Joseph (2002): Umweltsoziologie. In: Günter Endruweit und Gisela Trommsdorff (Hg.): Wörterbuch der Soziologie. 2. Aufl. Stuttgart: Lucius & Lucius, S. 641-645.
Kuckartz, Udo; Rheingans-Heintze, Anke (2006): Trends im Umweltbewusstsein. Umweltgerechtigkeit, Lebensqualität und persönliches Engagement. Herausgegeben vom Umweltbundesamt. Wiesbaden: VS Verlag für Sozialwissenschaften.
Voss, Martin (Hg.) (2010): Der Klimawandel. Sozialwissenschaftliche Perspektiven. Wiesbaden: VS Verlag für Sozialwissenschaften.
Weber, Melanie (2008): Alltagsbilder des Klimawandels. Zum Klimabewusstsein in Deutschland. Wiesbaden: VS Verlag für Sozialwissenschaften.

Course: Environmental Policy (Seminar)

Lecturer:
Monika Griefahn

Language:
DE

Cycle:
WS/SS

Content:
Environmental Policy and Sustainability
The thesis of this seminar is that sustainable development needs politics to provide framework legislation. Students are offered to take a look at the German “Energiewende” with all its different aspects, but also at sustainability from the point of view of other social actors. We survey the different levels of politics and their power, and we take a look at other actors in society like environmental NGOs, companies or other lobbyists. How do they interact, where is the power, what has a nation’s culture to do with it?
The seminar wants engineers to take a look beyond their own nose and to sensitize them that many actors with numerous opinions form the society their will have to work in. We emphasize a practical approach, so we invite speakers from different sectors of society – NGO, politics and economy – and offer exchange about numerous topics society is moved by. This holistic approach is the core element of the seminar. Students contribute by presentations and term papers.

Literature:
Eine Reihe grundlegender Monografien sowie wichtige Fachzeitschriften und Internetseiten werden im Seminar bekannt gegeben.

Course: Corporate Strategies (Vorlesung)

Lecturer:
Prof. Thomas Wrona

Language:
DE

Cycle:
SS

Content:
Introduction to the theory and practice of strategic management:
The major will be on different types of corporate strategies of selected methods for the analysis of external and internal factors affecting the company and the strategic management process. The acquired knowledge is practically applied on the basis of selected case studies in the lectures to make students familiar with the use and application of different analysis techniques. A guest speaker complements the content of the lecture by providing a practical perspective on strategic management.

Literature:
Bamberger, I. and T. Wrona (1996). "Der Ressourcenansatz und seine Bedeutung für die strategische Unternehmensführung." Schmalenbachs Zeitschrift für betriebswirtschaftliche Forschung (zfbf) 48 (2): 130-153.
Bamberger, I. and T. Wrona (2004). Strategische Unternehmensführung. Strategien, Systeme, Prozesse. München, Vahlen.
Johnson, G., K. Scholes, et al. (2006). Exploring corporate strategy. Text and cases. Harlow, Financial Times Prentice Hall.
Mintzberg, H. (1987). "The Strategy Concept I: Five Ps for Strategy." California Management Review(Fall): 11-24.
Müller-Stewens, G. and C. Lechner (2005). Strategisches Management – Wie strategische Initiativen zum Wandel führen. Stuttgart.
Porter, M. E. (1980). Competitive strategy. Techniques for analyzing industries and competitors New York, Free Press.
Porter, M. E. (1997). Wettbewerbsstrategie - Methoden zur Analyse von Branchen und Konkurrenten. Frankfurt a.M.
Steinmann, H. and G. Schreyögg (2005). Management - Grundlagen der Unternehmensführung. Wiesbaden, Gabler.
Welge, M. K. and A. Al-Laham (2008). Strategisches Management. Grundlagen – Prozess – Implementierung. Wiesbaden, Gabler.
Wheelen, T. L. and D. J. Hunger (2012). Strategic management and business policy. Toward global sustainability. Boston/Columbus et al., Pearson.

Course: Civil- & Business Law (Vorlesung)

Lecturer:
Markus A. Meyer-Chory

Language:
DE

Cycle:
SS

Content:
- Basics of German Law System
- System of Commercial and Civil Law
- selected parts of law incl. Commercial Law and Labor Law
- Methods of legal case studies
-actual cases - legal practice

Literature:
Notwendig
(in Klausur erlaubt):BGB - Bürgerliches Gesetzbuch , möglichst akutelle Auflage , dtv Beck-Texte 5001,
Empfohlen:
nENDERS/HETGER
Grundzüge der betrieblichen Rechtsfragen
4. Auflage, 2008
Richard Boorberg Verlag - ISBN 978-3-415-04005-2
http://www.beck-shop.de/Enders-Hetger-Grundz%C3%BCge-betrieblichen-Rechtsfragen/productview.aspx?product=36632&utm
nMüssig, Peter
Wirtschaftsprivatrecht
15. Auflage, 2012
C.F. Müller UTB - ISBN 978-3-81149476-3
http://www.beck-shop.de/Muessig-Wirtschaftsprivatrecht/productview.aspx?product=11974019
nGildeggen, Rainer, pp
Wirtschaftsprivatrecht
2., aktualisierte und erweiterte Auflage 2013. Buch. XXI, 406 S. Kartoniert
Oldenbourg ISBN 978-3-486-71662-7
http://www.beck-shop.de/Gildeggen-Lorinser-Willburger-Broenneke-Eisenberg-Harriehausen-Jautz-Reuthal-Schmitt-Schweizer-Tavakoli-

Thaele-Tybusseck-Lehr-Wi/productview.aspx?product=11808371
nLipperheide, Peter J.
Wirtschaftsprivatrecht
1. Auflage 2009
expert-Verlag - ISBN 978-3-8169-2770-9
http://www.beck-shop.de/Lipperheide-Wirtschaftsprivatrecht/productview.aspx?product=34250
nRing, Gerhard
Wirtschaftsrecht
1. Auflage 2013
Oldenbourg Verlag - ISBN 978-3-486-58664-0
http://www.beck-shop.de/Ring-Wirtschaftsrecht/productview.aspx?product=690200

Course: Business Ethics (Vorlesung)

Lecturer:
Dr. Michael Florian

Language:
DE

Cycle:
WS

Content:
Business ethics is concerned with the moral evaluation of economic behavior and the application of ethical principles in economy and management (e.g. "corporate social responsibility"). The lecture focuses on relevant theoretical concepts and controversial issues of business ethics as well as practical problems of implementation which will be analyzed on the basis of selected case studies.

Literature:
Aßländer, Michael S. (Hg.) (2011): Handbuch Wirtschaftsethik. Stuttgart, Weimar: Metzler
Beckert, Jens (2010): Sind Unternehmen sozial verantwortlich? In: Olaf J. Schumann, Alexander Brink und Thomas Beschorner (Hg.): Unternehmensethik. Forschungsperspektiven zur Verhältnisbestimmung von Unternehmen und Gesellschaft. Marburg: Metropolis, S. 109-124
Beschorner, Thomas; Hollstein, Bettina (Hg.) (2005): Wirtschafts- und Unternehmensethik. Rückblick, Ausblick, Perspektiven. München: Hampp
Corporate Citizenship. In: Aus Politik und Zeitgeschichte 58 (31) vom 28. Juli 2008
Enderle, Georges; Homann, Karl; Honecker, Martin (Hg.) (1993): Lexikon der Wirtschaftsethik. Freiburg, Basel, Wien: Herder.
Hiß, Stefanie (2006): Warum übernehmen Unternehmen gesellschaftliche Verantwortung? Ein soziologischer Erklärungsversuch. Frankfurt/Main [u.a.]: Campus Verlag
Homann, Karl; Lütge, Christoph (2005): Einführung in die Wirtschaftsethik. 2. Aufl. Münster: LIT
Lenk, Hans; Maring, Matthias (Hg.) (1992): Wirtschaft und Ethik. Stuttgart: Reclam
Luhmann, Niklas (1993): Wirtschaftsethik - als Ethik? In: Josef Wieland (Hg.): Wirtschaftsethik und Theorie der Gesellschaft. Frankfurt am Main: Suhrkamp, S. 134-147.
Noll, Bernd (2002): Wirtschafts- und Unternehmensethik in der Marktwirtschaft. Stuttgart: Kohlhammer.
Raupp, Juliana; Jarolimek, Stefan; Schultz, Friederike (Hg.) (2011): Handbuch Corporate Social Responsibility. Kommunikationswissenschaftliche Grundlagen, disziplinäre Zugänge und methodische Herausforderungen. VS Verlag für Sozialwissenschaften
Schranz, Mario: Wirtschaft zwischen Profit und Moral. Wiesbaden: VS Verlag für Sozialwissenschaften, 2007
Suchanek, Andreas (2007): Ökonomische Ethik. 2. Aufl. Tübingen: Mohr Siebeck/UTB
Ulrich, Peter (2008): Integrative Wirtschaftsethik. Grundlagen einer lebensdienlichen Ökonomie. 4. Aufl. Bern: Haupt
Wieland, Josef (1999): Die Ethik der Governance. Marburg: Metropolis-Verlag

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Course: Academic Research and Writing (Seminar)

Lecturer:
Thomas Hapke, Dr. Birte Schelling

Language:
DE

Cycle:
WS/SS

Content:
The seminar offers an introduction into the diverse aspects of academic research and writing: Finding the topic, finding specialized information, knowledge organisation, writing, presenting and publishing. Suggestions for reflecting own processes of learning, informing and writing - in addition to practical recommendations and tips - facilitate the start and the creation of bachelor and master theses, works, which bring thoroughly self-fulfillment and make fun.
Topics of the seminar will be in particular

- Scientific scholarship, learning and working: Introduction, organisation, attributes of science: How is scientific knowledge created? Theories of learning and practice, work scheduling, finding topics, time management, specialities of academic research in engineering
- Finding specialized information: Full texts and library resources, databases http://www.tub.tu-harburg.de/en/subject-information/informing-points-to-survive/
- Reference management: http://www.tub.tu-harburg.de/en/publishing/reference-management/

Knowledge organisation and creating publications with Citavi
- Citing correctly and avoiding plagiarism
- Preparing and doing presentations
- Academic writing: Formal and practivcal requirements for academic writing processes in engineering. Why writing? Criteria for good writing, methods of structuring, reading and extracting, revising text
- Personaliy and academic research and writing: Getting confidence and fun to write! Discovering your own type of writer, methods to avoid writer's block (free-writing) and to structure own thoughts (mind-mapping).

Literature:

1. Semesterapparat "Wissenschaftliches Arbeiten" in der TU-Bibliothek: http://www.tub.tuharburg.de/service/semesterapparate/?semapp=sem+wissa&semappname=Wissenschaftliches%20Arbeiten

2. Weblog Wissenschaftliches Arbeiten der TU-Bibliothek: http://www.tub.tu-harburg.de/wissenschaftliches-arbeiten/

3. Online-Tutorial VISION der TU-Bibliothek zum wissenschaftlichen Arbeiten: http://www.vision.tu-harburg.de

4. Studieren zwei null - Webportal zum wissenschaftlichen Arbeiten: http://www.studierenzweinull.de/

5. LOTSE http://lotse.uni-muenster.de/ingenieurwissenschaften/index-de.php?location=0

6. Werner Sesink: Einführung in das wissenschaftliche Arbeiten : inklusive E-Learning, Web-Recherche, digitale Präsentation u.a. 9., aktualisierte Aufl. München : Oldenbourg, 2012.

7. Judith Theuerkauf: Schreiben im Ingenieurstudium : effektiv und effizient zur Bachelor-, Master- und Doktorarbeit. Paderborn : Schöningh, 2012.
8. Biedermann, Wieland u.a.: Forschungsmethodik in den Ingenieurwissenschaften : Skript vom Lehrstuhl für Produktentwicklung, Prof. Dr.-Ing. Udo Lindemann, Technische Universität München (TUM), 2012. http://www.pe.mw.tum.de/fileadmin/w00bft/www/pdf/skript_forschungsmethodik_ingenieur.pdf

1. Course Reserves Collection "Scholarly Research Methods" in the TUHH library: http://www.tub.tu-harburg.de/en/service/course-reserve-collections/?semapp=sem+wissa&semappname=Wissenschaftliches%20Arbeiten
2. Scholarly research methods via TUHH library website: http://www.tub.tu-harburg.de/en/subject-information/scholarly-research-methods/
3. VISION – Online-Tutorial on research methods by the TUHH library: http://www.vision.tu-harburg.de
4. Scientific papers and presentations / Martha Davis. 3. ed. Amsterdam: Elsevier / Academic Press, 2013. http://www.sciencedirect.com/science/book/9780123847270
5. Writing for science and engineering : papers, presentations and reports / Heather Silyn-Roberts. 2nd ed. Amsterdam : Elsevier, 2013. http://www.sciencedirect.com/science/book/9780080982854
6. How to research / Loraine Blaxter, Christina Hughes and Malcolm Tight. Maidenhead : Open Univ. Press, 2010.
7. Managing information for research : practical help in researching, writing and designing dissertations / Elizabeth Orna and Graham Stevens. Maidenhead : Open University Press McGraw-Hill, 2009.
8. Writing scientific research articles : strategy and steps / Margaret Cargill and Patrick O'Connor. Chichester : Wiley-Blackwell, 2009.

Course: Time Management and Self-Organisation (Seminar)

Lecturer:
Sybille Hausburg

Language:
DE

Cycle:
WS/SS

Content:

- The students will learn different concepts of self management.
- They get views into stress and motivation research and by assistance of suitable tools, they question there own work techniques and develop suggestions for improvement.
- They learn to deal with motivation weaknesses and procrastination, to set themselves goals and identify priorities.
- Different planning methods and tools will be presented and tested for longer-, medium- and short-term periods.

Literature:

Allen, David: Wie ich die Dinge geregelt kriege (Getting Things done), Piper Verlag 2012
Corsten, Hans u.a.: Technik des wissenschaftlichen Arbeitens, Oldenbourg Verlag 2008
Echterhoff, Gerald u.a.: Projekt- und Zeitmanagement, Klett Verlag 2006
Heister, Werner: Studieren mit Erfolg: Effizientes Lernen und Selbstmanagement: in Bachelor-, Master- und Diplomstudiengängen, Schäffer-Poeschel-Verlag 2009

Heister, Werner u.a.: Studieren mit Erfolg: Prüfungen meistern. Klausuren, Kolloquien, Präsentationen, Bewerbungsgespräche; Schäffer-Poeschel-Verlag 2007
Jäger, Roland: Selbstmanagement und persönliche Arbeitstechniken, Wettenberg Verlag 2007
Metzger, Christoph: Lern- und Arbeitstechniken, Cornelsen Verlag 2007
Peirick, Christian: Rationelle Lesetechniken, Bock Verlag 2008
Rost, Friedrich: Lern- und Arbeitstechniken für das Studium, VS Verlag für Sozialwissenschaften 2008
Seiwert, Lothar: Noch mehr Zeit für das Wesentliche. Zeitmanagement neu entdecken, Goldmann Verlag 2009
Stollreiter, Marc u.a.: Stress-Management Das WAAGE-Programm, Beltz Verlag 2000

Specialisation Civil- and Enviromental Engeneering

Module: Structural Analysis I

Courses:

Title	Typ	Hrs/wk
Structural Analysis I	Vorlesung	2
Structural Analysis I	Hörsaalübung	2

Module Responsibility:
Prof. Uwe Starossek

Admission Requirements:

anics I, Mathematics I

Recommended Previous Knowledge:
Mechanics I, Mathematics I

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
After successfully completing this module, students can express the basic aspects of linear frame analysis of statically determinate systems.

Capabilities:
After successful completion of this module, the students are able to distinguish between statically determinate and indeterminate structures. They are able to analyze state variables and to construct influence lines of statically determinate plane and spatial frame and truss structures.

Personal Competence:
Social Competence:

Autonomy:
The students are able work in-term homework assignments. Due to the in-term feedback, they are enabled to self-assess their learning progress during the lecture period, already.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Civil- and Enviromental Engeneering: Compulsory
Civil- and Environmental Engeneering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Civil- and Enviromental Engeneering: Compulsory
Technomathematics: Vertiefung Engineering Science: Compulsory suffrage

Course: Structural Analysis I (Vorlesung)

Lecturer:
Prof. Uwe Starossek

Language:
DE

Cycle:
WS

Content:
Statically determinate structural systems

- basics: statically determinacy, equilibrium, method of sections
- forces: determination of support reactions and internal forces
- influence lines of forces
- displacements: calculation of discrete displacements and rotations, calculation of deflection curves
- principle of virtual displacements and virtual forces
- work-engergy theorem
- differential equation of beam

Literature:
Krätzig, W.B., Harte, R., Meskouris, K., Wittek, U.: Tragwerke 1 – Theorie und Berechnungsmethoden statisch bestimmter Stabtragwerke. 4. Aufl., Springer, Berlin, 1999.

Course: Structural Analysis I (Übung)

Lecturer:
Prof. Uwe Starossek

Language:
DE

Cycle:
WS

Content:
Statically determinate structural systems

- basics: statically determinacy, equilibrium, method of sections
- forces: determination of support reactions and internal forces
- influence lines of forces
- displacements: calculation of discrete displacements and rotations, calculation of deflection curves
- principle of virtual displacements and virtual forces
- work-engergy theorem
- differential equation of beam

Literature:
Krätzig, W.B., Harte, R., Meskouris, K., Wittek, U.: Tragwerke 1 – Theorie und Berechnungsmethoden statisch bestimmter Stabtragwerke. 4. Aufl., Springer, Berlin, 1999.

Module: Reinforced Concrete I

Courses:

Title	Typ	Hrs/wk
Project Seminar Concrete I	Seminar	1
Reinforced Concrete Design I	Vorlesung	2
Reinforced Concrete Design I	Hörsaalübung	2

Module Responsibility:
Prof. Viktor Sigrist

Admission Requirements:
none

Recommended Previous Knowledge:
Basic knowledge in structural analysis and building materials.

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students can outline the history of concrete construction and explain the basics of structural engineering, including usual load combinations and safety concepts. They are able to draft and dimension simple structures, as well as to evaluate and discuss the behaviour of the materials and of structural members.

Capabilities:
The students are able to apply basic procedures of the conception and dimensioning to practical cases. They are capable to draft simple concrete structures and to design them for bending and bending with axial force, and to plan their detailing and execution. Moreover, they can make design and construction sketches and draw up technical descriptions.

Personal Competence:
Social Competence:
Autonomy:
The students are able to carry out simple tasks in the conception and dimensioning of structures and to critically reflect the results.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 110, Study Time in Lecture: 70

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Civil- and Enviromental Engeneering: Compulsory
Civil- and Environmental Engeneering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Civil- and Enviromental Engeneering: Compulsory

Course: Project Seminar Concrete I (Seminar)

Lecturer:
Prof. Viktor Sigrist

Language:
DE

Cycle:
SS

Content:
In the course of the project seminar, a simple structure is drafted and dimensioned.

Literature:

Course: Reinforced Concrete Design I (Vorlesung)

Lecturer:
Prof. Viktor Sigrist

Language:
DE

Cycle:

SS

Content:

The following subjects/contents are treated:

- history of concrete construction
- mechanical and physical-chemical properties od concrete and steel
- bond between concrete and reinforcement
- concepts for dimensioning, limit state models, structural safety
- design of linear members for tension and bending with and without axial force

Literature:

Download der Unterlagen zur Vorlesung über Stud.IP!

Course: Reinforced Concrete Design I (Übung)

Lecturer:

Prof. Viktor Sigrist

Language:

DE

Cycle:

SS

Content:

The following subjects/contents are treated:

- history of concrete construction
- mechanical and physical-chemical properties od concrete and steel
- bond between concrete and reinforcement
- concepts for dimensioning, limit state models, structural safety
- design of linear members for tension and bending with and without axial force

Literature:

Download der Unterlagen zur Vorlesung über Stud.IP!

Module: Signals and Systems

Courses:

Title	Typ	Hrs/wk
Signals and Systems	Vorlesung	3
Signals and Systems	Hörsaalübung	1

Module Responsibility:
Prof. Gerhard Bauch

Admission Requirements:
Mathematics 1-3

Recommended Previous Knowledge:

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students are able to classify and describe signals and linear time-invariant (LTI) systems using methods of signal and system theory. They are able to apply the fundamental transformations of continuous-time and discrete-time signals and systems. They can describe and analyse deterministic signals and systems mathematically in both time and image domain. In particular, they understand the effects in time domain and image domain which are caused by the transition of a continuous-time signal to a discrete-time signal.
Capabilities:
The students are able to describe and analyse deterministic signals and linear time-invariant systems using methods of signal and system theory. They can analyse and design basic systems regarding important properties such as magnitude and phase response, stability, linearity etc.. They can assess the impact of LTI systems on the signal properties in time and frequency domain.

Personal Competence:
Social Competence:
The students can jointly solve specific problems.
Autonomy:
The students are able to acquire relevant information from appropriate literature sources. They can control their level of knowledge during the lecture period by solving tutorial problems, software tools, clicker system.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Electrical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Computer Science and Engineering: Compulsory
General Engineering Science (German program): Vertiefung Chemical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (German program): Vertiefung Civil- and Enviromental Engeneering: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Biomedical Engineering: Compulsory
Computer Science: Kernqualifikation: Compulsory
Electrical Engineering: Kernqualifikation: Compulsory
Electrical Engineering myTrack: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Civil- and Enviromental Engeneering: Compulsory
General Engineering Science (English program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (English program): Vertiefung Electrical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Computer Science and Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Chemical Engineering: Compulsory
Computational Science and Engineering: Kernqualifikation: Compulsory
Mechatronics: Kernqualifikation: Compulsory
Technomathematics: Vertiefung Engineering Science: Compulsory suffrage

Course: Signals and Systems (Vorlesung)

Lecturer:
Prof. Gerhard Bauch

Language:
DE/EN

Cycle:
SS

Content:

- Basic classification and description of continuous-time and discrete-time signals and systems
- Concvolution
- Power and energy of signals
- Correlation functions of deterministic signals
- Linear time-invariant (LTI) systems
- Signal transformations:
  - Fourier-Series
  - Fourier Transform
  - Laplace Transform
  - Discrete-time Fourier Transform
  - Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT)
  - Z-Transform
- Analysis and design of LTI systems in time and frequency domain
- Basic filter types
- Sampling, sampling theorem
- Fundamentals of recursive and non-recursive discrete-time filters

Literature:

- T. Frey , M. Bossert , Signal- und Systemtheorie, B.G. Teubner Verlag 2004
- K. Kammeyer, K. Kroschel, Digitale Signalverarbeitung, Teubner Verlag.
- B. Girod ,R. Rabensteiner , A. Stenger , Einführung in die Systemtheorie, B.G. Teubner, Stuttgart, 1997
- J.R. Ohm, H.D. Lüke , Signalübertragung, Springer-Verlag 8. Auflage, 2002
- S. Haykin, B. van Veen: Signals and systems. Wiley.
- Oppenheim, A.S. Willsky: Signals and Systems. Pearson.
- Oppenheim, R. W. Schafer: Discrete-time signal processing. Pearson.

Course: Signals and Systems (Übung)

Lecturer:
Prof. Gerhard Bauch

Language:
DE/EN

Cycle:
SS

Content:

- Basic classification and description of continuous-time and discrete-time signals and systems
- Concvolution
- Power and energy of signals
- Correlation functions of deterministic signals
- Linear time-invariant (LTI) systems
- Signal transformations:
  - Fourier-Series
  - Fourier Transform
  - Laplace Transform
  - Discrete-time Fourier Transform
  - Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT)
  - Z-Transform
- Analysis and design of LTI systems in time and frequency domain
- Basic filter types
- Sampling, sampling theorem
- Fundamentals of recursive and non-recursive discrete-time filters

Literature:

- T. Frey , M. Bossert , Signal- und Systemtheorie, B.G. Teubner Verlag 2004
- K. Kammeyer, K. Kroschel, Digitale Signalverarbeitung, Teubner Verlag.
- B. Girod ,R. Rabensteiner , A. Stenger , Einführung in die Systemtheorie, B.G. Teubner, Stuttgart, 1997
- J.R. Ohm, H.D. Lüke , Signalübertragung, Springer-Verlag 8. Auflage, 2002
- S. Haykin, B. van Veen: Signals and systems. Wiley.
- Oppenheim, A.S. Willsky: Signals and Systems. Pearson.
- Oppenheim, R. W. Schafer: Discrete-time signal processing. Pearson.

Module: Geotechnics I

Courses:

Title	Typ	Hrs/wk
Soil Mechanics	Vorlesung	2
Soil Mechanics	Problemorientierte Lehrveranstaltung	2
Soil Mechanics	Hörsaalübung	2

Module Responsibility:
Prof. Jürgen Grabe

Admission Requirements:
none

Recommended Previous Knowledge:
Mechanics

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students know the basics of soil mechanics as the structure and characteristics of soil, stress distribution due to weight, water or structures, consolidation and settlement calculations, as well as failure of the soil due to ground- or slope failure.
Capabilities:
After the successful completion of the module the students should be able to describe the mechanical properties and to evaluate them with the help of geotechnical standard tests. They can calculate stresses and deformation in the soils due to weight or influence of structures. They are are able to prove the usability (settlements) for shallow foundations.

Personal Competence:
Social Competence:
Autonomy:

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 96, Study Time in Lecture: 84

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Civil- and Enviromental Engeneering: Compulsory
Civil- and Environmental Engeneering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Civil- and Enviromental Engeneering: Compulsory

Course: Soil Mechanics (Vorlesung)

Lecturer:
Prof. Jürgen Grabe

Language:
DE

Cycle:
SS

Content:

- Structure of the soil
- Ground surveying
- Compsitition and properties of the soil
- Groundwater
- One-dimensional compression
- Spreading of stresses
- Settlement calculation
- Consolidation
- Shear strength
- Earth pressure
- Slope failure
- Ground failure
- Suspension based earth tenches

Literature:

- Vorlesungsumdruck, s. ww.tu-harburg.de/gbt
- Grabe, J. (2004): Bodenmechanik und Grundbau
- Gudehus, G. (1981): Bodenmechanik
- Kolymbas, D. (1998): Geotechnik - Bodenmechanik und Grundbau
- Grundbau-Taschenbuch, Teil 1, aktuelle Auflage

Course: Soil Mechanics (Problemorientierte Lehrveranstaltung)

Lecturer:
Prof. Jürgen Grabe

Language:
DE

Cycle:
SS

Content:

- Structure of the soil
- Ground surveying
- Compsitition and properties of the soil
- Groundwater
- One-dimensional compression
- Spreading of stresses
- Settlement calculation
- Consolidation
- Shear strength
- Earth pressure
- Slope failure
- Ground failure
- Suspension based earth tenches

Literature:

- Vorlesungsumdruck, s. ww.tu-harburg.de/gbt
- Grabe, J. (2004): Bodenmechanik und Grundbau
- Gudehus, G. (1981): Bodenmechanik
- Kolymbas, D. (1998): Geotechnik - Bodenmechanik und Grundbau
- Grundbau-Taschenbuch, Teil 1, aktuelle Auflage

Course: Soil Mechanics (Übung)

Lecturer:
Prof. Jürgen Grabe

Language:
DE

Cycle:
SS

Content:

- Structure of the soil
- Ground surveying
- Compsitition and properties of the soil
- Groundwater
- One-dimensional compression
- Spreading of stresses
- Settlement calculation
- Consolidation
- Shear strength
- Earth pressure
- Slope failure
- Ground failure
- Suspension based earth tenches

Literature:

- Vorlesungsumdruck, s. ww.tu-harburg.de/gbt
- Grabe, J. (2004): Bodenmechanik und Grundbau
- Gudehus, G. (1981): Bodenmechanik
- Kolymbas, D. (1998): Geotechnik - Bodenmechanik und Grundbau
- Grundbau-Taschenbuch, Teil 1, aktuelle Auflage

Module: Structural Analysis II

Courses:

Title	Typ	Hrs/wk
Structural Analysis II	Vorlesung	2
Structural Analysis II	Hörsaalübung	2

Module Responsibility:
Prof. Uwe Starossek

Admission Requirements:

Recommended Previous Knowledge:

- Mechanics I/II
- Mathematics I/II
- Differential Equations I
- Structural Analysis I

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
After successful completion of this module, students can express the basic aspects of linear frame analysis of statically indeterminate systems.

Capabilities:
After successful completion of this module, the students are able to analyze state variables and to construct influence lines of statically inderminate plane and spatial frame and truss structures.

Personal Competence:
Social Competence:
Autonomy:
The students are able to work in-term homework assignments. Due to the in-term feedback, they are enabled to self-assess their learning progress during the lecture period, already.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Civil- and Enviromental Engeneering: Compulsory
Civil- and Environmental Engeneering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Civil- and Enviromental Engeneering: Compulsory

Course: Structural Analysis II (Vorlesung)

Lecturer:
Prof. Uwe Starossek

Language:
DE

Cycle:
SS

Content:

- Linear structural analysis: statically indeterminate systems
- force method

- slope-deflection method for sway and non-sway frames
- general displacement method and finite element method

Literature:

Krätzig, W. B.; Harte, R.; Meskouris, K.; Wittek, U.: Tragwerke 2 – Theorie und Berechnungsmethoden statisch unbestimmter Stabtragwerke, 4. Auflage, Berlin, 2004

Course: Structural Analysis II (Übung)

Lecturer:

Prof. Uwe Starossek

Language:

DE

Cycle:

SS

Content:

- Linear structural analysis: statically indeterminate systems
- force method
- slope-deflection method for sway and non-sway frames
- general displacement method and finite element method

Literature:

Krätzig, W. B.; Harte, R.; Meskouris, K.; Wittek, U.: Tragwerke 2 – Theorie und Berechnungsmethoden statisch unbestimmter Stabtragwerke, 4. Auflage, Berlin, 2004

Courses:

Title	Typ	Hrs/wk
Introduction to Management	Vorlesung	4
Project Entrepreneurship	Problemorientierte Lehrveranstaltung	2

Module Responsibility:
Prof. Kathrin Fischer

Admission Requirements:
None

Recommended Previous Knowledge:
Basic Knowledge of Mathematics and Business

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
After taking this module, students know the important basics of many different areas in Business and Management, from Planning and Organisation to Marketing and Innovation, and also to Investment and Controlling. In particular they are able to

- explain the differences between Economics and Management and the sub-disciplines in Management and to name important definitions from the field of Management
- explain the most important aspects of and goals in Management and name the most important aspects of entreprneurial projects
- describe and explain basic business functions as production, procurement and sourcing, supply chain management, organization and human ressource management, information management, innovation management and marketing
- explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives and uncertainty, and explain some basic methods from mathematical Finance
- state basics from accounting and costing and selected controlling methods.

Capabilities:
Students are able to analyse business units with respect to different criteria (organization, objectives, strategies etc.) and to carry out an Entrepreneurship project in a team. In particular, they are able to

- analyse Management goals and structure them appropriately
- analyse organisational and staff structures of companies
- apply methods for decision making under multiple objectives, under uncertainty and under risk
- analyse production and procurement systems and Business information systems
- analyse and apply basic methods of marketing
- select and apply basic methods from mathematical finance to predefined problems
- apply basic methods from accounting, costing and controlling to predefined problems

Personal Competence:
Social Competence:
Students are able to

- work successfully in a team of students
- to apply their knowledge from the lecture to an entrepreneurship project and write a coherent report on the project
- to communicate appropriately and
- to cooperate respectfully with their fellow students.

Autonomy:
Students are able to

- work in a team and to organize the team themselves
- to write a report on their project.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 96, Study Time in Lecture: 84

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Electrical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Computer Science and Engineering: Compulsory
General Engineering Science (German program): Vertiefung Chemical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Bioprocess Engineering: Compulsory

General Engineering Science (German program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (German program): Vertiefung Civil- and Enviromental Engeneering: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Naval Architecture: Compulsory
Civil- and Environmental Engeneering: Kernqualifikation: Compulsory
Bioprocess Engineering: Kernqualifikation: Compulsory
Computer Science: Kernqualifikation: Compulsory
Electrical Engineering: Kernqualifikation: Compulsory
Electrical Engineering myTrack: Kernqualifikation: Compulsory
Energy and Environmental Engineering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Civil- and Enviromental Engeneering: Compulsory
General Engineering Science (English program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (English program): Vertiefung Electrical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (English program): Vertiefung Computer Science and Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Naval Architecture: Compulsory
General Engineering Science (English program): Vertiefung Chemical Engineering: Compulsory
Computational Science and Engineering: Kernqualifikation: Compulsory
Logistics and Mobility: Kernqualifikation: Compulsory
Mechanical Engineering: Kernqualifikation: Compulsory
Mechatronics: Kernqualifikation: Compulsory
Naval Architecture: Kernqualifikation: Compulsory
Technomathematics: Kernqualifikation: Compulsory
Process Engineering: Kernqualifikation: Compulsory

Course: Introduction to Management (Vorlesung)

Lecturer:
Prof. Kathrin Fischer, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Cornelius Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona

Language:
DE

Cycle:
WS/SS

Content:

- Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management
- Important definitions from Management,
- Developing Objectives for Business, and their relation to important Business functions
- Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supply Chain Management, Innovation Management, Marketing and Sales
  Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management
- Definitions as information, information systems, aspects of data security and strategic information systems
- Definition and Relevance of innovations, e.g. innovation opporunities, risks etc.
- Relevance of marketing, B2B vs. B2C-Marketing
- different techniques from the field of marketing (e.g. scenario technique), pricing strategies
- important organizational structures
- basics of human ressource management
- Introduction to Business Planning and the steps of a planning process
- Decision Analysis: Elements of decision problems and methods for solving decision problems
- Selected Planning Tasks, e.g. Investment and Financial Decisions
- Introduction to Accounting: Accounting, Balance-Sheets, Costing
- Relevance of Controlling and selected Controlling methods
- Important aspects of Entrepreneurship projects

Literature:
Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008
Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003
Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006.
Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001.
Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgart 2008.
Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeine Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005.
Weber, J., Schäffer, U. : Einführung in das Controlling, 12. Auflage, Stuttgart 2008.
Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006.

Course: Project Entrepreneurship (Problemorientierte Lehrveranstaltung)

Lecturer:
Prof. Christoph Ihl

Language:
DE

Cycle:
WS/SS

Content:
In this project module, students work on an Entrepreneurship project. They are required to go through all relevant steps, from the first idea to the concept, using their knowledge from the corresponding lecture.
Project work is carried out in teams with the support of a mentor.

Literature:
Relevante Literatur aus der korrespondierenden Vorlesung.

Courses:

Title	Typ	Hrs/wk
Building Physics	Vorlesung	2
Building Physics	Hörsaalübung	1
Building Physics	Gruppenübung	1
Principles of Building Materials	Vorlesung	2

Module Responsibility:
Prof. Frank Schmidt-Döhl

Admission Requirements:
None

Recommended Previous Knowledge:
Knowledge of physics, chemistry and mathematics from school

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students are able to identify fundamental effects of action to materials and structures, to explain different types of mechanical behaviour, to describe the structure of building materials and the correlations between structure and other properties, to show methods of joining and of corrosion processes and to describe the most important regularities and properties of building materials and structures and their measurement in the field of protection against moisture, coldness, fire and noise.
Capabilities:
The students are able to work with the most important standardized methods and regularities in the field of moisture protection, the German regulation for energy saving, fire protection and noise protection in the case of a small building.

Personal Competence:
Social Competence:
The students are able to support each other to learn the very extensive specialist knowledge.
Autonomy:
The students are able to make the timing and the operation steps to learn the specialist knowledge of a very extensive field.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 96, Study Time in Lecture: 84

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Civil- and Enviromental Engeneering: Compulsory
Civil- and Environmental Engeneering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Civil- and Enviromental Engeneering: Compulsory
Technomathematics: Vertiefung Engineering Science: Compulsory suffrage

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Course: Building Physics (Vorlesung)

Lecturer:
Prof. Frank Schmidt-Döhl

Language:
DE

Cycle:
WS

Content:
Heat transport, thermal bridges, balances of energy consumption, German regulation for energy saving, heat protection in summer, moisture transport, condensation moisture, protection against mold, fire protection,
noise protection

Literature:
Fischer, H.-M. ; Freymuth, H.; Häupl, P.; Homann, M.; Jenisch, R.; Richter, E.; Stohrer, M.: Lehrbuch der Bauphysik. Vieweg und Teubner Verlag, Wiesbaden, ISBN 978-3-519-55014-3

Course: Building Physics (Übung)

Lecturer:
Prof. Frank Schmidt-Döhl

Language:
DE

Cycle:
WS

Content:
Heat transport, thermal bridges, balances of energy consumption, German regulation for energy saving, heat protection in summer, moisture transport, condensation moisture, protection against mold, fire protection,
noise protection

Literature:
Fischer, H.-M. ; Freymuth, H.; Häupl, P.; Homann, M.; Jenisch, R.; Richter, E.; Stohrer, M.: Lehrbuch der Bauphysik. Vieweg und Teubner Verlag, Wiesbaden, ISBN 978-3-519-55014-3

Course: Building Physics (Übung)

Lecturer:
Prof. Frank Schmidt-Döhl

Language:
DE

Cycle:
WS

Content:
Heat transport, thermal bridges, balances of energy consumption, German regulation for energy saving, heat protection in summer, moisture transport, condensation moisture, protection against mold, fire protection,
noise protection

Literature:
Fischer, H.-M. ; Freymuth, H.; Häupl, P.; Homann, M.; Jenisch, R.; Richter, E.; Stohrer, M.: Lehrbuch der Bauphysik. Vieweg und Teubner Verlag, Wiesbaden, ISBN 978-3-519-55014-3

Course: Principles of Building Materials (Vorlesung)

Lecturer:
Prof. Frank Schmidt-Döhl

Language:
DE

Cycle:
WS

Content:
Structure of building materials
Effects of action
Fundamentals of mechanical behaviour
Principles of metals
Joining methods
Corrosion

Literature:
Wendehorst, R.: Baustoffkunde. ISBN 3-8351-0132-3
Scholz, W.:Baustoffkenntnis. ISBN 3-8041-4197-8

Module: Steel Structures I

Courses:

Title	Typ	Hrs/wk
Steel Structures I	Vorlesung	2
Steel Structures I	Hörsaalübung	2

Module Responsibility:
Dr. Jürgen Priebe

Admission Requirements:
none

Recommended Previous Knowledge:

- Loads on structures
- Basics of structural analysis
- Basics of mechanics
- Basics of materials - steel

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
After passing this module students are able to

- give a summary of the security concept
- explain the priciples of the design process
- describe and illustrate the bhaviour of memers in tension, compression and bending

Capabilities:
Students can rate and apply the material steel appropiately with respect to its properties and usage.
They can use the security concept with respect to loads, forces and resistances.
They can check the ultimate limit state and the serviceability of simple members in tension, compression and bending.

Personal Competence:
Social Competence:
After participation of an optional course (building of a simple truss) they are able to organize themselves in groups. They will be successful in guided building a truss with bolted connections according to design drawings.
Autonomy:

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Civil- and Enviromental Engeneering: Compulsory
Civil- and Environmental Engeneering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Civil- and Enviromental Engeneering: Compulsory

Course: Steel Structures I (Vorlesung)

Lecturer:
Dr. Jürgen Priebe, Prof. Uwe Starossek

Language:
DE

Cycle:
WS

Content:

- Introduction to steel constructions
- Materials
- Design and security model
- Tension rods
- Beams (elsatic and plastic design
- Column design
- Bolted connections

Literature:
Petersen, C.: Stahlbau, 4. Auflage 2013, Springer-Vieweg Verlag
Wagenknecht, G.: Stahlbau-Praxis nach Eurocode 3, Bauwerk-Verlag 2011

- Band 1 Tragwerksplanung, Grundlagen
- Band 2 Verbindungen und Konstruktionen

Course: Steel Structures I (Übung)

Lecturer:
Dr. Jürgen Priebe

Language:
DE

Cycle:
WS

Content:

- Introduction to steel constructions
- Materials
- Design and security model
- Tension rods
- Beams (elsatic and plastic design
- Column design
- Bolted connections

Literature:
Petersen, C.: Stahlbau, 4. Auflage 2013, Springer-Vieweg Verlag
Wagenknecht, G.: Stahlbau-Praxis nach Eurocode 3, Bauwerk-Verlag 2011

- Band 1 Tragwerksplanung, Grundlagen
- Band 2 Verbindungen und Konstruktionen

Module: Concrete Structures II

Courses:

Title	Typ	Hrs/wk
Project Concrete Structures II	Projektseminar	1
Concrete Structures II	Vorlesung	3
Concrete Structures II	Hörsaalübung	1

Module Responsibility:
Prof. Günter Rombach

Admission Requirements:
none

Recommended Previous Knowledge:

- Knowledge of loads on structures and combination of actions
- Basics of safety format are required.
- Knowledge in design of beams and columns for ultimate limit state

(see module 'Concrete Structures I')

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students know the basic principles which arev required for design of reinforced concrete structures. They know the various methods to estimate the member forces in simple one and two-way slabs.
Capabilities:

- The students can design reinforced concrete structure in the ultimate limit state (shear, bending, torsion) and in the serviceability limit state (crack and deflection control) including detailing (anchorage and links etc.).
- The students can estimate the member forces of simple slabs.
- The students know the content and the layout of a structural analysis

Personal Competence:
Social Competence:
Cooperation in a project work, where they design in a team a real concrete building and present the results at the end.
Autonomy:

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 110, Study Time in Lecture: 70

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Civil- and Enviromental Engeneering: Compulsory
Civil- and Environmental Engeneering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Civil- and Enviromental Engeneering: Compulsory

Course: Project Concrete Structures II (Projektseminar)

Lecturer:
Prof. Günter Rombach

Language:
DE

Cycle:
WS

Content:
Design of a truss structure

Literature:
Skript zur Lehrveranstaltung "Stahlbetonbau II"

Course: Concrete Structures II (Vorlesung)

Lecturer:

Prof. Günter Rombach

Language:
DE

Cycle:
WS

Content:

- Design of concrete members for shear, punching and torsion
- Design for serviceability limit state (durability): crack- and deflection control
- Detailing
- Introduction in the design of plates
- Layout and content of a structural design

Literature:

- Vorlesungsumdrucke
- König G., Tue N.: Grundlagen des Stahlbetonbaus. Teubner Verlag, Stuttgart 1998
- Zilch K., Zehetmaier G.: Bemessung im konstruktiven Betonbau. Springer Verlag, 2010
- Deutscher Beton- und Bautechnikverein E.V.: Beispiele zur Bemessung von Betontragwerken nach Eurocode 2. Band 1: Hochbau, Bauverlag GmbH, Wiesbaden 2011
- Dahms K.-H.: Rohbauzeichnungen, Bewehrungszeichnungen. Bauverlag, Wiesbaden 1997
- Grasser E. ,Thielen G.: Hilfsmittel zur Berechnung der Schnittgrößen und Formänderungen von Stahlbetontragwerken. Deutscher Ausschuss für Stahlbeton, Heft 240, Verlag Ernst & Sohn, Berlin 1978
- DIN EN 1992-1-1:2011: Bemessung und Konstruktion von Stahlbeton- und Spannbetontragwerken – Teil 1: Allgemeine Bemessungsregeln für den Hochbau.

Course: Concrete Structures II (Übung)

Lecturer:
Prof. Günter Rombach

Language:
DE

Cycle:
WS

Content:

- Design of concrete members for shear, punching and torsion
- Design for serviceability limit state (durability): crack- and deflection control
- Detailing
- Introduction in the design of plates
- Layout and content of a structural design

Literature:

- Vorlesungsumdrucke
- König G., Tue N.: Grundlagen des Stahlbetonbaus. Teubner Verlag, Stuttgart 1998
- Zilch K., Zehetmaier G.: Bemessung im konstruktiven Betonbau. Springer Verlag, 2010
- Deutscher Beton- und Bautechnikverein E.V.: Beispiele zur Bemessung von Betontragwerken nach Eurocode 2. Band 1: Hochbau, Bauverlag GmbH, Wiesbaden 2011
- Dahms K.-H.: Rohbauzeichnungen, Bewehrungszeichnungen. Bauverlag, Wiesbaden 1997
- Grasser E. ,Thielen G.: Hilfsmittel zur Berechnung der Schnittgrößen und Formänderungen von Stahlbetontragwerken. Deutscher Ausschuss für Stahlbeton, Heft 240, Verlag Ernst & Sohn, Berlin 1978
- DIN EN 1992-1-1:2011: Bemessung und Konstruktion von Stahlbeton- und Spannbetontragwerken – Teil 1: Allgemeine Bemessungsregeln für den Hochbau.

Module: Hydraulic Engineering I

Courses:

Title	Typ	Hrs/wk
Hydrology	Vorlesung	1
Hydrology	Problemorientierte Lehrveranstaltung	1
Hydromechanics	Vorlesung	2
Hydromechanics	Hörsaalübung	1

Module Responsibility:
Prof. Peter Fröhle

Admission Requirements:
none

Recommended Previous Knowledge:
Mathematics I, II and III
Mechanik I und II

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students are able to define the basic terms of hydromechanics and hydrology and water management. They are able to derive the basic formulations of i) hydrostatics, ii) kinematics of flows and iii) conservation laws and to describe and quantify the relevant processes of the hydrological water cycle. Besides, the students can describe the main aspects of rainfall-run-off-modelling and of established reservoir / storage models as well as the concepts of the determination of a unit-hydrograph.
Capabilities:
The students are able to apply the fundamental formulations of hydromechanics to basic practical problems. Besides this, they are able to apply basic hydrological approaches and methods to simple hydrological problems. The students have the capability to exemplarily apply simple reservoir/storage models and a unit-hydrograph to given problems.
In addition, the basic concepts of field – measurements of hydrological and hydrodynamic values can be described and the students are able to perform, analyze and assess respective measurements.

Personal Competence:
Social Competence:
The students are able to prepare and present technical presentations for given topics in groups.

Autonomy:
Students can provide each other with feedback and suggestions on their results. They are capable of reflecting their study techniques and learning strategy on an individual basis.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 110, Study Time in Lecture: 70

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Civil- and Enviromental Engeneering: Compulsory
Civil- and Environmental Engeneering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Civil- and Enviromental Engeneering: Compulsory

Course: Hydrology (Vorlesung)

Lecturer:
Prof. Peter Fröhle

Language:
DE

Cycle:
WS

Content:
Introduction to basics of Hydrology:

- Hydrological cycle
- Data acquisition

- Data analyses and statistical assessment
- Statistics of extremes
- Regionalization methods for hydrological values

Rainfall-run-off modelling on the basis of a unit hydrograph conceps

Literature:
Maniak, Hydrologie und Wasserwirtschaft, Eine Einführung für Ingenieure, Springer
Skript Hydrologie und Gewässerkunde

Course: Hydrology (Problemorientierte Lehrveranstaltung)

Lecturer:
Prof. Peter Fröhle

Language:
DE

Cycle:
WS

Content:
Introduction to basics of Hydrology:

- Hydrological cycle
- Data acquisition
- Data analyses and statistical assessment
- Statistics of extremes
- Regionalization methods for hydrological values

Rainfall-run-off modelling on the basis of a unit hydrograph conceps

Literature:
Maniak, Hydrologie und Wasserwirtschaft, Eine Einführung für Ingenieure, Springer
Skript Hydrologie und Gewässerkunde

Course: Hydromechanics (Vorlesung)

Lecturer:
Prof. Peter Fröhle

Language:
DE

Cycle:
WS

Content:
Fundamentals of Hydromechanics

- Characteristics of fluids
- Hydrostatics
- Kinematics of flows, laminar and turbulent flows
- Conservation laws
  - Conservation of mass
  - Conservation of Energy
  - Momentum Equation
- Application of conservation laws to flow conditions

Literature:
Skript zur Vorlesung Hydromechanik/Hydraulik, Kapitel 1-2
E-Learning Werkzeug: Hydromechanik und hydraulik (Link): (http://www.tu-harburg.de/ … hydraulik_tool/index.html)
Truckenbrodt, E.: Lehrbuch der angewandten Fluidmechanik, Springer Verlag, Berlin, 1998.
Truckenbrodt, E.: Grundlagen und elementare Strömungsvorgänge dichtebeständiger Fluide / Fluidmechanik, Springer Verlag, Berlin, 1996.

Course: Hydromechanics (Übung)

Lecturer:
Prof. Peter Fröhle

Language:
DE

Cycle:
WS

Content:
Fundamentals of Hydromechanics

- Characteristics of fluids
- Hydrostatics
- Kinematics of flows, laminar and turbulent flows
- Conservation laws
  - Conservation of mass
  - Conservation of Energy
  - Momentum Equation
- Application of conservation laws to flow conditions

Literature:
Skript zur Vorlesung Hydromechanik/Hydraulik, Kapitel 1-2
E-Learning Werkzeug: Hydromechanik und hydraulik (Link): (http://www.tu-harburg.de/ … hydraulik_tool/index.html)
Truckenbrodt, E.: Lehrbuch der angewandten Fluidmechanik, Springer Verlag, Berlin, 1998.
Truckenbrodt, E.: Grundlagen und elementare Strömungsvorgänge dichtebeständiger Fluide / Fluidmechanik, Springer Verlag, Berlin, 1996.

Module: Geotechnics II

Courses:

Title	Typ	Hrs/wk
Foundation Engineering	Vorlesung	2
Foundation Engineering	Problemorientierte Lehrveranstaltung	2
Foundation Engineering	Hörsaalübung	2

Module Responsibility:
Prof. Jürgen Grabe

Admission Requirements:
none

Recommended Previous Knowledge:
Mechanics, Soilmechanics

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students know the basic principles and methods which are required to verificate the stability of geotechnical structures.
Capabilities:
After successful completion of the module the students are able to:

- verificate the stability and usability of foundations,
- know individual methods of ground improvement and apply them in their range of application,
- design retaining walls.

Personal Competence:
Social Competence:
Autonomy:

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 96, Study Time in Lecture: 84

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Civil- and Enviromental Engeneering: Compulsory
Civil- and Environmental Engeneering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Civil- and Enviromental Engeneering: Compulsory

Course: Foundation Engineering (Vorlesung)

Lecturer:
Prof. Jürgen Grabe

Language:
DE

Cycle:
WS

Content:

- Shallow foundations
- Pile foundations
- Ground improvement
- Retaining walls
- Underpinning
- Groundwater Conservation
- Cut-off Walls

Literature:

- Vorlesung/Übung s. www.tu-harburg.de/gbt
- Grabe, J. (2004): Bodenmechanik und Grundbau
- Kolymbas, D. (1998): Geotechnik - Bodenmechanik und Grundbau

- Grundbau-Taschenbuch, neueste Auflage

Course: Foundation Engineering (Problemorientierte Lehrveranstaltung)

Lecturer:
Prof. Jürgen Grabe

Language:
DE

Cycle:
WS

Content:

- Shallow foundations
- Pile foundations
- Ground improvement
- Retaining walls
- Underpinning
- Groundwater Conservation
- Cut-off Walls

Literature:

- Vorlesung/Übung s. www.tu-harburg.de/gbt
- Grabe, J. (2004): Bodenmechanik und Grundbau
- Kolymbas, D. (1998): Geotechnik - Bodenmechanik und Grundbau
- Grundbau-Taschenbuch, neueste Auflage

Course: Foundation Engineering (Übung)

Lecturer:
Prof. Jürgen Grabe

Language:
DE

Cycle:
WS

Content:

- Shallow foundations
- Pile foundations
- Ground improvement
- Retaining walls
- Underpinning
- Groundwater Conservation
- Cut-off Walls

Literature:

- Vorlesung/Übung s. www.tu-harburg.de/gbt
- Grabe, J. (2004): Bodenmechanik und Grundbau
- Kolymbas, D. (1998): Geotechnik - Bodenmechanik und Grundbau
- Grundbau-Taschenbuch, neueste Auflage

Module: Sanitary Engineering

Courses:

Title	Typ	Hrs/wk
Wastewater Disposal	Vorlesung	2
Wastewater Disposal	Hörsaalübung	1
Drinking Water Supply	Vorlesung	2
Drinking Water Supply	Hörsaalübung	1

Module Responsibility:
Prof. Stephan Köster

Admission Requirements:
none

Recommended Previous Knowledge:

- Basic knowledge on Chemistry and Biology
- Hydraulics of pipe systems and open channels
- Basic knowledge on water management: water quantity and water quality
- Basic knowledge on Environmental Legislation: Federal Water Act

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students can examplify their expert knowledge on urban water infrastructures. They can present the derivation and detailed explanation of important standards for the design of drinking water supply and wastewater disposal systems in Germany and they are capable of reproducing the relevant empiricals assumptions and scientific simplifcations. The students are able to present and discuss sanitary engineering processes and the technologies used for drinking and wastewater treatment. They can also assess existing problems in the field of sanitary engineering by considering legal, risk and saftey aspects. Furthermore, they know how to draft the features and effectiveness of important technologies of the future such as high- and low-pressure membrane filtration systems and techniques for the removal of trace pollutants.

Capabilities:
The students are able to apply the relevant standards and guidelines for the design and operation of urban water infrastructures independently. Their expertise comprises expert skills to design drinking water supply and urban drainage systems as well as the associated treatment facilities. Besides the acquirement of technical skills the students are able to address and solve biochemical problems in the filed of drinking water and wastewater treatment. The students are also able to develop ideas of their own to improve the existing water related infrastructures, systems and concepts.

Personal Competence:
Social Competence:
Students are able to form concepts on their own to optimize urban water infrastructure processes. Therefore they can acquire appropriate knowledge when being given some clues or information with regard to the approach to problems (preparation and follow-up of the exercises).

Autonomy:

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 96, Study Time in Lecture: 84

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Civil- and Enviromental Engeneering: Compulsory
Civil- and Environmental Engeneering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Civil- and Enviromental Engeneering: Compulsory

Course: Wastewater Disposal (Vorlesung)

Lecturer:
Prof. Stephan Köster

Language:
DE

Cycle:
SS

Content:
This lecture focusses on urban drainage and wastewater treatment.
Urban Drainage

- Design of urban drainage systems (combined and separate sewer systems)
- Special structures
- Rainwater management

Wastewater treatement

- Mechanical treatment (Screens, Grit chamber, Preliminary Sedimentation, Secondary Settlement Tanks, Membrane Filtration)
- Biological Treatment (aerobic, anaerobic, anoxic)
- Special Wastewater Treatment Processes (Ozonation, Adsorption)

Literature:
Die hier aufgeführte Literatur ist in der Bibliothek der TUHH verfügbar.
The literature listed below is available in the library of the TUHH.

- Taschenbuch der Stadtentwässerung : mit 10 Tafeln und 67 Tabellen, Imhoff, K., & . (2009). (31., verbesserte Aufl.). Munchen: Oldenbourg Industrieverl.
- Abwasser : Technik und Kontrolle. Neitzel, Volkmar, and. . Weinheim [u.a.]: Wiley-VCH, 1998.
- Kommunale Kläranlagen : Bemessung, Erweiterung, Optimierung, Betrieb und Kosten, (2009). Gunthert, F. Wolfgang: (3., vollig neu bearb. Aufl.). Renningen: expert-Verl.
- Water and wastewater technology Hammer, M. J. 1., & . (2012). (7. ed., internat. ed.). Boston [u.a.]: Pearson Education International.
- Water and wastewater engineering : design principles and practice: Davis, M. L. 1. (2011). . New York, NY: McGraw-Hill.
- Biological wastewater treatment: (2011). C. P. Leslie Grady, Jr. (3. ed.). London, Boca Raton, Fla. [u.a.]: IWA Publ.

Course: Wastewater Disposal (Übung)

Lecturer:
Prof. Stephan Köster

Language:
DE

Cycle:
SS

Content:
This lecture focusses on urban drainage and wastewater treatment.
Urban Drainage

- Design of urban drainage systems (combined and separate sewer systems)
- Special structures
- Rainwater management

Wastewater treatement

- Mechanical treatment (Screens, Grit chamber, Preliminary Sedimentation, Secondary Settlement Tanks, Membrane Filtration)
- Biological Treatment (aerobic, anaerobic, anoxic)
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- Abwasser : Technik und Kontrolle. Neitzel, Volkmar, and. . Weinheim [u.a.]: Wiley-VCH, 1998.
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- Water and wastewater technology Hammer, M. J. 1., & . (2012). (7. ed., internat. ed.). Boston [u.a.]: Pearson Education International.
- Water and wastewater engineering : design principles and practice: Davis, M. L. 1. (2011). . New York, NY: McGraw-Hill.
- Biological wastewater treatment: (2011). C. P. Leslie Grady, Jr. (3. ed.). London, Boca Raton, Fla. [u.a.]: IWA Publ.

Course: Drinking Water Supply (Vorlesung)

Lecturer:
Dr. Klaus Johannsen, Prof. Mathias Ernst

Language:
DE

Cycle:
SS

Content:
The lecture on drinking water supply provides students with a basic understanding of the entire water supply system, encompassing water catchment, water treatment including pump systems, water storage, and the distribution system that carries water to the consumer.
Initially, basics in hydraulics and pump systems are presented (system curve and pump curve). Students learn how the duty point of the pump is determined. Students learn about different water resources and will be able to design groundwater wells. Students learn how to determine water demand and derive planning values for designing the different elements of a water supply system (e.g. firefighting requirements). The functions of reservoirs, their design and arrangement in the water supply system are explained. Students will be able to design simple water distribution systems.
A further part of the lecture deals with the processes involved in drinking water supply. This includes a presentation of the essential mechanisms and layout parameters for sedimentation, filtration, coagulation, membrane treatment, adsorption, water softening, gas exchange, ion exchange and disinfection. The basics of process treatment technology will be built on with parallel analysis of the impacts on chemical and physical water quality parameters.

Literature:
Gujer, Willi (2007): Siedlungswasserwirtschaft. 3., bearb. Aufl., Springer-Verlag.
Karger, R., Cord-Landwehr, K., Hoffmann, F. (2005): Wasserversorgung. 12., vollst. überarb. Aufl., Teubner Verlag
Rautenberg, J. et al. (2014): Mutschmann/Stimmelmayr Taschenbuch der Wasserversorgung. 16. Aufl., Springer-Vieweg Verlag.
DVGW Lehr- und Handbuch Wasserversorgung: Wasseraufbereitung - Grundlagen und Verfahren, m. CD-ROM: Band 6 (2003).

Course: Drinking Water Supply (Übung)

Lecturer:
Dr. Klaus Johannsen, Prof. Mathias Ernst

Language:
DE

Cycle:
SS

Content:
The lecture on drinking water supply provides students with a basic understanding of the entire water supply system, encompassing water catchment, water treatment including pump systems, water storage, and the distribution system that carries water to the consumer.
Initially, basics in hydraulics and pump systems are presented (system curve and pump curve). Students learn how the duty point of the pump is determined. Students learn about different water resources and will be able to design groundwater wells. Students learn how to determine water demand and derive planning values for designing the different elements of a water supply system (e.g. firefighting requirements). The functions of reservoirs, their design and arrangement in the water supply system are explained. Students will be able to design simple water distribution systems.
A further part of the lecture deals with the processes involved in drinking water supply. This includes a presentation of the essential mechanisms and layout parameters for sedimentation, filtration, coagulation, membrane treatment, adsorption, water softening, gas exchange, ion exchange and disinfection. The basics of process treatment technology will be built on with parallel analysis of the impacts on chemical and physical water quality parameters.

Literature:
Gujer, Willi (2007): Siedlungswasserwirtschaft. 3., bearb. Aufl., Springer-Verlag.
Karger, R., Cord-Landwehr, K., Hoffmann, F. (2005): Wasserversorgung. 12., vollst. überarb. Aufl., Teubner Verlag
Rautenberg, J. et al. (2014): Mutschmann/Stimmelmayr Taschenbuch der Wasserversorgung. 16. Aufl., Springer-Vieweg Verlag.
DVGW Lehr- und Handbuch Wasserversorgung: Wasseraufbereitung - Grundlagen und Verfahren, m. CD-ROM: Band 6 (2003).

Module: Hydraulic Engineering II

Courses:

Title	Typ	Hrs/wk
Hydraulics	Vorlesung	1
Hydraulics	Hörsaalübung	1
Hydraulic Engineering	Vorlesung	2
Hydraulic Engineering	Hörsaalübung	1

Module Responsibility:
Prof. Peter Fröhle

Admission Requirements:
none

Recommended Previous Knowledge:
Hydraulik Engineering I

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students are able to define the basic terms of hydraulic engineering and hydraulics. They are able to explain the application of basic hydrodynamic formulations (conservation laws) to practical hydraulic engineering problems. Besides this, the students can illustrate important tasks of hydraulic engineering and give an overview over river engineering, flood protection, hydraulic power engineering and waterways engineering.
Capabilities:
The students are able to apply hydraulic engineering methods and approaches to basic practical problems and design respective hydraulic engineering systems. Besides this, they are able to use and apply established approaches of hydraulics and determine water surfaces of channel flows, influences of constructions (weirs, etc.) on channel flows as well as flow conditions of pipe system.

Personal Competence:
Social Competence:
Autonomy:

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 110, Study Time in Lecture: 70

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Civil- and Enviromental Engeneering: Compulsory
Civil- and Environmental Engeneering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Civil- and Enviromental Engeneering: Compulsory

Course: Hydraulics (Vorlesung)

Lecturer:
Prof. Peter Fröhle

Language:
DE

Cycle:
SS

Content:
Flow of incompressible fluids in pipes and open channels

- Hydraulics of pipes
- Punps in hydraulic systems
- Open channel flow
- Regulative construction in open channel flow
  - Weirs
  - Sliding panels
  - Cross-section reduction by constructions

Literature:

Zanke, Ulrich C. , Hydraulik für den WasserbauUrsprünglich erschienen unter: Schröder/Zanke "Technische Hydraulik", Springer-Verlag, 2003
Naudascher, E.: Hydraulik der Gerinne und Gerinnebauwerke, Springer, 1992

Course: Hydraulics (Übung)

Lecturer:
Prof. Peter Fröhle

Language:
DE

Cycle:
SS

Content:
Flow of incompressible fluids in pipes and open channels

- Hydraulics of pipes
- Punps in hydraulic systems
- Open channel flow
- Regulative construction in open channel flow
  - Weirs
  - Sliding panels
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Literature:
Zanke, Ulrich C. , Hydraulik für den WasserbauUrsprünglich erschienen unter: Schröder/Zanke "Technische Hydraulik", Springer-Verlag, 2003
Naudascher, E.: Hydraulik der Gerinne und Gerinnebauwerke, Springer, 1992

Course: Hydraulic Engineering (Vorlesung)

Lecturer:
Prof. Peter Fröhle

Language:
DE

Cycle:
SS

Content:
Fundamentals of hydraulic engineering

- Introduction and hydrological cycle
- River engineering
  - Regime theory of natural rivers
  - Sediment transport
  - Regulation of rivers
  - Bank protection / protection of river bed
  - Tidal rivers
- Flood protection
  - Dikes
  - Flood contraol basins
- Hydraulic power
- Inland waterways engineering
  - waterways
  - Locks and ship lifts
  - Fish passages
- Nature-oriented hydraulic engineering

Literature:
Strobl, T. & Zunic, F: Wasserbau, Springer 2006
Patt, H. & Gonsowski, P: Wasserbau, Springer 2011

Course: Hydraulic Engineering (Übung)

Lecturer:
Prof. Peter Fröhle

Language:
DE

Cycle:
SS

Content:
Fundamentals of hydraulic engineering

- Introduction and hydrological cycle
- River engineering
  - Regime theory of natural rivers
  - Sediment transport
  - Regulation of rivers
  - Bank protection / protection of river bed
  - Tidal rivers
- Flood protection
  - Dikes
  - Flood contraol basins
- Hydraulic power
- Inland waterways engineering
  - waterways
  - Locks and ship lifts
  - Fish passages
- Nature-oriented hydraulic engineering

Literature:
Strobl, T. & Zunic, F: Wasserbau, Springer 2006
Patt, H. & Gonsowski, P: Wasserbau, Springer 2011

Specialisation Bioprocess Engineering

Module: Fundamentals of Process Engineering

Courses:

Title	Typ	Hrs/wk
Introduction into Process Engineering/Bioprocess Engineering	Vorlesung	2
Fundamentals of Technical Drawing and Materials	Vorlesung	1
Fundamentals of Technical Drawing and Materials	Hörsaalübung	1
Environmental Technologie	Vorlesung	2

Module Responsibility:
Prof. Michael Schlüter

Admission Requirements:
none

Recommended Previous Knowledge:
none

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
After passing this module the students have the ability to:

- give an overview of the most important fields on process and bioprocess engineering,
- explain some working methods for different fields in process engineering.

Capabilities:
After passing this module the students should have the ability to:

- list and outline the most important fields of process engineering,
- name the most important working approaches or methods of the different fields of process engineering,
- read and prepare an engineering drawing,
- explain the most important technologies for wastewater and exhaust air treatment
- scheme typical chemical and biotechnological processes independently with the aid of pointers.

Personal Competence:
Social Competence:
The students are able to

- work out results in groups and document them,
- provide appropriate feedback and handle feedback on their own performance constructively.

Autonomy:
The students are able to estimate their progress of learning by themselves and to deliberate their lack of knowledge in Process Engineering and Bioprocess Engineering.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 96, Study Time in Lecture: 84

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Chemical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Bioprocess Engineering: Compulsory
Bioprocess Engineering: Kernqualifikation: Compulsory

General Engineering Science (English program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (English program): Vertiefung Chemical Engineering: Compulsory
Technomathematics: Vertiefung Engineering Science: Compulsory suffrage
Process Engineering: Kernqualifikation: Compulsory

Course: Introduction into Process Engineering/Bioprocess Engineering (Vorlesung)

Lecturer:
Dozenten des SD V

Language:
DE

Cycle:
WS

Content:
Introduction into the different research fields of the subject Process Engineering and Bioprocess Engineering.

Literature:
s. StudIP

Course: Fundamentals of Technical Drawing and Materials (Vorlesung)

Lecturer:
Dr. Marko Hoffmann

Language:
DE

Cycle:
WS

Content:

- Technical drawing basics (contents, kinds of drawings and generation of drawings according to relevant standards)
- Projective geometry (basics, orthographic projections, isometric projections, cuts, developed views, penetration views)

Literature:

- Hesser, Wilfried; Hoischen, Hans: "Technisches Zeichnen", 33., überarb. und aktualisierte Aufl, Cornelsen Verlag, Berlin, 2011
- Labisch, Susanna; Weber, Christian: "Technisches Zeichnen", 4. überarbeitete und erweiterte Auflage, Springer Vieweg Verlag, Wiesbaden, 2013
- Kurz, Ulrich; Wittel, Herbert: "Böttcher/Forberg Technisches Zeichnen", 26. überarbeitete und erweiterte Auflage, Springer Vieweg Verlag, Wiesbaden, 2014

Course: Fundamentals of Technical Drawing and Materials (Übung)

Lecturer:
Dr. Marko Hoffmann

Language:
DE

Cycle:
WS

Content:

- Technical drawing basics (contents, kinds of drawings and generation of drawings according to relevant standards)
- Projective geometry (basics, orthographic projections, isometric projections, cuts, developed views, penetration views)

Literature:

- Hesser, Wilfried; Hoischen, Hans: "Technisches Zeichnen", 33., überarb. und aktualisierte Aufl, Cornelsen Verlag, Berlin, 2011
- Labisch, Susanna; Weber, Christian: "Technisches Zeichnen", 4. überarbeitete und erweiterte Auflage, Springer Vieweg Verlag,

Wiesbaden, 2013
- Kurz, Ulrich; Wittel, Herbert: "Böttcher/Forberg Technisches Zeichnen", 26. überarbeitete und erweiterte Auflage, Springer Vieweg Verlag, Wiesbaden, 2014

Course: Environmental Technologie (Vorlesung)

Lecturer:
Prof. Kerstin Kuchta, Dr. Wolfgang Ahlf

Language:
DE

Cycle:
WS

Content:

1. Introductory seminar on environmental science:
2. Environmental impact and adverse effects
3. Wastewater technology
4. Air pollution control
5. Noise protection
6. Waste and recycling management
7. Soil and ground water protection
8. Renewable energies
9. Resource conservation and energy efficiency

Literature:
Förster, U.: Umweltschutztechnik; 2012; Springer Berlin (Verlag) 8., Aufl. 2012; 978-3-642-22972-5 (ISBN)

Courses:

Title	Typ	Hrs/wk
Fundamentals of Fluid Mechanics	Vorlesung	2
Exercises in Fluid Mechanics for Process Engineering	Hörsaalübung	1

Module Responsibility:
Prof. Michael Schlüter

Admission Requirements:

- Mathematics I+II+III
- Technical Mechanics I+II
- Technical Thermodynamics I+II

Recommended Previous Knowledge:

- Working with force balances
- Simplification and solving of partial differential equations
- Integration

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students are able to:

- explain the difference between different types of flow
- give an overview for different applications of the Reynolds Transport-Theorem in process engineering
- explain simplifications of the Continuity- and Navier-Stokes-Equation by using physical boundary conditions

Capabilities:
The students are able to

- describe and model incompressible flows mathematically
- reduce the governing equations of fluid mechanics by simplifications to archive quantitative solutions e.g. by integration
- notice the dependency between theory and technical applications
- use the learned basics for fluid dynamical applications in fields of process engineering

Personal Competence:
Social Competence:
The students

- are capable to gather information from subject related, professional publications and relate that information to the context of the lecture and
- able to work together on subject related tasks in small groups. They are able to present their results effectively in English (e.g. during small group exercises)

Autonomy:
The students are able to

- search further literature for each topic and to expand their knowledge with this literature,
- work on their exercises by their own and to evaluate their actual knowledge with the feedback.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 138, Study Time in Lecture: 42

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Chemical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (German program): Vertiefung Energy and Enviromental Engineering: Compulsory
Bioprocess Engineering: Kernqualifikation: Compulsory
Energy and Environmental Engineering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (English program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (English program): Vertiefung Chemical Engineering: Compulsory
Technomathematics: Vertiefung Engineering Science: Compulsory suffrage

Course: Fundamentals of Fluid Mechanics (Vorlesung)

Lecturer:
Prof. Michael Schlüter

Language:
DE

Cycle:
SS

Content:

- fluid properties
- hydrostatic
- overall balances - theory of streamline
- overall balances- conservation equations
- differential balances - Navier Stokes equations
- irrotational flows - Potenzialströmungen
- flow around bodies - theory of physical similarity
- turbulent flows
- compressible flows

Literature:

1. Crowe, C. T.: Engineering fluid mechanics. Wiley, New York, 2009.
2. Durst, F.: Strömungsmechanik: Einführung in die Theorie der Strömungen von Fluiden. Springer-Verlag, Berlin, Heidelberg, 2006.
3. Fox, R.W.; et al.: Introduction to Fluid Mechanics. J. Wiley & Sons, 1994
4. Herwig, H.: Strömungsmechanik: Eine Einführung in die Physik und die mathematische Modellierung von Strömungen. Springer Verlag, Berlin, Heidelberg, New York, 2006
5. Herwig, H.: Strömungsmechanik: Einführung in die Physik von technischen Strömungen: Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008
6. Kuhlmann, H.C.: Strömungsmechanik. München, Pearson Studium, 2007
7. Oertl, H.: Strömungsmechanik: Grundlagen, Grundgleichungen, Lösungsmethoden, Softwarebeispiele. Vieweg+ Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2009
8. Schade, H.; Kunz, E.: Strömungslehre. Verlag de Gruyter, Berlin, New York, 2007
9. Truckenbrodt, E.: Fluidmechanik 1: Grundlagen und elementare Strömungsvorgänge dichtebeständiger Fluide. Springer-Verlag, Berlin, Heidelberg, 2008
10. Schlichting, H. : Grenzschicht-Theorie. Springer-Verlag, Berlin, 2006
11. van Dyke, M.: An Album of Fluid Motion. The Parabolic Press, Stanford California, 1882.
12. White, F.: Fluid Mechanics, Mcgraw-Hill, ISBN-10: 0071311211, ISBN-13: 978-0071311212, 2011

Course: Exercises in Fluid Mechanics for Process Engineering (Übung)

Lecturer:
Prof. Michael Schlüter

Language:
DE

Cycle:
SS

Content:
The Exercise-Lecture will bridge the gap between the theoretical content from the lecture and the practical calculations for the homework exercises. For this aim a special exercise is calculated at the blackboard that shows how the theoretical knowledge from the lecture can be used to solve real problems in Process Engineering.

Literature:

1. Crowe, C. T.: Engineering fluid mechanics. Wiley, New York, 2009.
2. Durst, F.: Strömungsmechanik: Einführung in die Theorie der Strömungen von Fluiden. Springer-Verlag, Berlin, Heidelberg, 2006.
3. Fox, R.W.; et al.: Introduction to Fluid Mechanics. J. Wiley & Sons, 1994
4. Herwig, H.: Strömungsmechanik: Eine Einführung in die Physik und die mathematische Modellierung von Strömungen. Springer Verlag, Berlin, Heidelberg, New York, 2006
5. Herwig, H.: Strömungsmechanik: Einführung in die Physik von technischen Strömungen: Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008
6. Kuhlmann, H.C.: Strömungsmechanik. München, Pearson Studium, 2007
7. Oertl, H.: Strömungsmechanik: Grundlagen, Grundgleichungen, Lösungsmethoden, Softwarebeispiele. Vieweg+ Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2009
8. Schade, H.; Kunz, E.: Strömungslehre. Verlag de Gruyter, Berlin, New York, 2007
9. Truckenbrodt, E.: Fluidmechanik 1: Grundlagen und elementare Strömungsvorgänge dichtebeständiger Fluide. Springer-Verlag,

Berlin, Heidelberg, 2008
10. Schlichting, H. : Grenzschicht-Theorie. Springer-Verlag, Berlin, 2006
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Courses:

Title	Typ	Hrs/wk
Thermodynamics III	Vorlesung	2
Thermodynamics III	Gruppenübung	1
Thermodynamics III	Hörsaalübung	1

Module Responsibility:
Prof. Irina Smirnova

Admission Requirements:

Recommended Previous Knowledge:
Mathematics, Physical Chemistry, Thermodynamics I and II

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:

- Starting from the very basics of thermodynamics, the students learn the mathematical tools to describe thermodynamic equilibria.
- They learn how state variables are influenced by the mixing of compounds and learn concepts to quantitatively describe these properties.
- Moreover, the students learn how phase equilibria can be described mathematically and which phenomena may occur if different phases (vapor, liquid, solid) coexist in equilibrium. Furthermore the fundamentals of reaction equilibria are taught.
- For different phase equilibria, several examples relevant for different kinds of processes are shown and the necessary knowledge for plotting and interpreting the equilibria are taught.

Capabilities:

- Applying their knowledge, the students are able to identify the correct equation for the determination of the equilibrium state and know how to simplify these equations meaningfully.
- The students know models which can be used to determine the properties of the system in the equilibrium state and they are able to solve the resulting mathematical relations.
- For specific applications, they are able to self-reliantly find necessary physico-chemical properties of compounds as well as model parameters in literature sources.
- Beside pure compound properties the students are capable of describing the properties of mixtures.
- The students know how to visualize phase equilibria graphically and they know how to interpret the occurring phenomena.
- Based on their knowledge, the students are able to understand fundamental concepts that are the basis for many separation and reaction processes in chemical engineering.

Personal Competence:
Social Competence:
Autonomy:

- The students are able to find necessary information self-reliantly in literature sources and to judge their quality.
- During the semester the students are able to check their learning progress continuously in exercises. Based on this knowledge the students can adept their learning process.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Chemical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Bioprocess Engineering: Compulsory
Bioprocess Engineering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (English program): Vertiefung Chemical Engineering: Compulsory
Process Engineering: Kernqualifikation: Compulsory

Course: Thermodynamics III (Vorlesung)

Lecturer:
Prof. Irina Smirnova

Language:
DE

Cycle:
SS

Content:

1. Introduction: Applications of thermodynamics of mixtures
2. Thermodynamic equations in multi-component systems: Fundamental equations, chemical potential, fugacity
3. Phase equilibria of pure substances: thermodynamic equilibrium, vapor pressure, Gibbs' phase rule
4. Equations of state: virial equations, van-der-Waals equation, generalized equations of state
5. Mixing properties: ideal and real mixtures, excess properties, partial molar properties
6. Vapor-liquid-equilibria: binary systems, azeotropes, equilibrium condition
7. Gas-liquid-equilibria: equilibrium condition, Henry-coefficient
8. G^E-Models: Hildebrand-model, Flory-Huggins-model, Wilson-model, UNIQUAC, UNIFAC
9. Liquid-liquid-equilibria: equilibrium condition, phase equilibria in binary and ternary systems
10. Solid-liquid-equilibria: equilibrium condition, binary systems
11. Chemical reactions: reaction coordinate, mass action law, influence of pressure and temperature
12. Osmotic pressure

Literature:

- Jürgen Gmehling, Bärbel Kolbe: Thermodynamik. VCH 1992
- J.M. Prausnitz, R.N. Lichtenthaler, E.G. de Azevedo: Molecular Thermodynamics of Fluid-Phase Equilibria, 3rd ed. Prentice Hall, 1999.
- J.W. Tester, M. Modell: Thermodynamics and its Applications. 3rd ed. Prentice Hall, 1997.J.P. O´Connell, J.M. Haile: Thermodynamics. Cambridge University Press, 2005.

Course: Thermodynamics III (Übung)

Lecturer:
Prof. Irina Smirnova

Language:
DE

Cycle:
SS

Content:

1. Introduction: Applications of thermodynamics of mixtures
2. Thermodynamic equations in multi-component systems: Fundamental equations, chemical potential, fugacity
3. Phase equilibria of pure substances: thermodynamic equilibrium, vapor pressure, Gibbs' phase rule
4. Equations of state: virial equations, van-der-Waals equation, generalized equations of state
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10. Solid-liquid-equilibria: equilibrium condition, binary systems
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- J.M. Prausnitz, R.N. Lichtenthaler, E.G. de Azevedo: Molecular Thermodynamics of Fluid-Phase Equilibria, 3rd ed. Prentice Hall, 1999.
- J.W. Tester, M. Modell: Thermodynamics and its Applications. 3rd ed. Prentice Hall, 1997.J.P. O´Connell, J.M. Haile: Thermodynamics. Cambridge University Press, 2005.

Course: Thermodynamics III (Übung)

Lecturer:
Prof. Irina Smirnova

Language:
DE

Cycle:
SS

Content:

1. Introduction: Applications of thermodynamics of mixtures
2. Thermodynamic equations in multi-component systems: Fundamental equations, chemical potential, fugacity
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7. Gas-liquid-equilibria: equilibrium condition, Henry-coefficient
8. G^E-Models: Hildebrand-model, Flory-Huggins-model, Wilson-model, UNIQUAC, UNIFAC
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12. Osmotic pressure

Literature:

- Jürgen Gmehling, Bärbel Kolbe: Thermodynamik. VCH 1992
- J.M. Prausnitz, R.N. Lichtenthaler, E.G. de Azevedo: Molecular Thermodynamics of Fluid-Phase Equilibria, 3rd ed. Prentice Hall, 1999.
- J.W. Tester, M. Modell: Thermodynamics and its Applications. 3rd ed. Prentice Hall, 1997.J.P. O´Connell, J.M. Haile: Thermodynamics. Cambridge University Press, 2005.

Module: Signals and Systems

Courses:

Title	Typ	Hrs/wk
Signals and Systems	Vorlesung	3
Signals and Systems	Hörsaalübung	1

Module Responsibility:
Prof. Gerhard Bauch

Admission Requirements:
Mathematics 1-3

Recommended Previous Knowledge:

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students are able to classify and describe signals and linear time-invariant (LTI) systems using methods of signal and system theory. They are able to apply the fundamental transformations of continuous-time and discrete-time signals and systems. They can describe and analyse deterministic signals and systems mathematically in both time and image domain. In particular, they understand the effects in time domain and image domain which are caused by the transition of a continuous-time signal to a discrete-time signal.
Capabilities:
The students are able to describe and analyse deterministic signals and linear time-invariant systems using methods of signal and system theory. They can analyse and design basic systems regarding important properties such as magnitude and phase response, stability, linearity etc.. They can assess the impact of LTI systems on the signal properties in time and frequency domain.

Personal Competence:
Social Competence:
The students can jointly solve specific problems.
Autonomy:
The students are able to acquire relevant information from appropriate literature sources. They can control their level of knowledge during the lecture period by solving tutorial problems, software tools, clicker system.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Electrical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Computer Science and Engineering: Compulsory
General Engineering Science (German program): Vertiefung Chemical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (German program): Vertiefung Civil- and Enviromental Engeneering: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Biomedical Engineering: Compulsory
Computer Science: Kernqualifikation: Compulsory
Electrical Engineering: Kernqualifikation: Compulsory
Electrical Engineering myTrack: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Civil- and Enviromental Engeneering: Compulsory
General Engineering Science (English program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (English program): Vertiefung Electrical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Computer Science and Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Chemical Engineering: Compulsory
Computational Science and Engineering: Kernqualifikation: Compulsory
Mechatronics: Kernqualifikation: Compulsory
Technomathematics: Vertiefung Engineering Science: Compulsory suffrage

Course: Signals and Systems (Vorlesung)

Lecturer:
Prof. Gerhard Bauch

Language:
DE/EN

Cycle:
SS

Content:

- Basic classification and description of continuous-time and discrete-time signals and systems
- Concvolution
- Power and energy of signals
- Correlation functions of deterministic signals
- Linear time-invariant (LTI) systems
- Signal transformations:
  - Fourier-Series
  - Fourier Transform
  - Laplace Transform
  - Discrete-time Fourier Transform
  - Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT)
  - Z-Transform
- Analysis and design of LTI systems in time and frequency domain
- Basic filter types
- Sampling, sampling theorem
- Fundamentals of recursive and non-recursive discrete-time filters

Literature:

- T. Frey , M. Bossert , Signal- und Systemtheorie, B.G. Teubner Verlag 2004
- K. Kammeyer, K. Kroschel, Digitale Signalverarbeitung, Teubner Verlag.
- B. Girod ,R. Rabensteiner , A. Stenger , Einführung in die Systemtheorie, B.G. Teubner, Stuttgart, 1997
- J.R. Ohm, H.D. Lüke , Signalübertragung, Springer-Verlag 8. Auflage, 2002
- S. Haykin, B. van Veen: Signals and systems. Wiley.
- Oppenheim, A.S. Willsky: Signals and Systems. Pearson.
- Oppenheim, R. W. Schafer: Discrete-time signal processing. Pearson.

Course: Signals and Systems (Übung)

Lecturer:
Prof. Gerhard Bauch

Language:
DE/EN

Cycle:
SS

Content:

- Basic classification and description of continuous-time and discrete-time signals and systems
- Concvolution
- Power and energy of signals
- Correlation functions of deterministic signals
- Linear time-invariant (LTI) systems
- Signal transformations:
  - Fourier-Series
  - Fourier Transform
  - Laplace Transform
  - Discrete-time Fourier Transform
  - Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT)
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- Analysis and design of LTI systems in time and frequency domain
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- B. Girod ,R. Rabensteiner , A. Stenger , Einführung in die Systemtheorie, B.G. Teubner, Stuttgart, 1997
- J.R. Ohm, H.D. Lüke , Signalübertragung, Springer-Verlag 8. Auflage, 2002
- S. Haykin, B. van Veen: Signals and systems. Wiley.
- Oppenheim, A.S. Willsky: Signals and Systems. Pearson.
- Oppenheim, R. W. Schafer: Discrete-time signal processing. Pearson.

Module: Biochemistry and Microbiology

Courses:

Title	Typ	Hrs/wk
Biochemistry	Vorlesung	2
Biochemistry	Problemorientierte Lehrveranstaltung	1
Microbiology	Vorlesung	2
Microbiology	Problemorientierte Lehrveranstaltung	1

Module Responsibility:
Prof. Rudolf Müller

Admission Requirements:
none

Recommended Previous Knowledge:
none

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
At the end of this module the students can:
- explain the methods of biological and biochemical research to determine the properties of biomolecules
- name the basic components of a living organism
- explain the principles of metabolism
- describe the structure of living cells
-

Capabilities:

Personal Competence:
Social Competence:
The students are able,
- to gather knowledge in groups of about 10 students
- to introduce their own knowledge and to argue their view in discussions in teams
- to divide a complex task into subtasks, solve these and to present the combined results

Autonomy:
The students are able to present the results of their subtasks in a written report

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 96, Study Time in Lecture: 84

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Bioprocess Engineering: Compulsory
Bioprocess Engineering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Bioprocess Engineering: Compulsory
Technomathematics: Vertiefung Engineering Science: Compulsory suffrage

Course: Biochemistry (Vorlesung)

Lecturer:
Prof. Rudolf Müller

Language:
DE

Cycle:
SS

Content:

1. The molecular logic of Life
2. Biomolecules:
    1. Amino acids, peptides, proteins
    2. Carbohydrates
    3. Lipids
3. Protein functions, Enzymes:

   1. Michaelis-Menten kinetics
   2. Enzyme regulation
   3. Enzyme nomenclature
4. Cofactors and cosubstrates, vitamines
5. Metabolism:
   1. Basic principles
   2. Photosynthesis
   3. Glycolysis
   4. Citric acid cycle
   5. Respiration
   6. Anaerobic respirations
   7. Fatty acid metabolism
   8. Amino acid metabolism

Literature:

Biochemie, H. Robert Horton, Laurence A. Moran, K. Gray Scrimeour, Marc D. Perry, J. David Rawn, Pearson Studium, München
Prinzipien der Biochemie, A. L. Lehninger, de Gruyter Verlag Berlin

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Course: Biochemistry (Problemorientierte Lehrveranstaltung)

Lecturer:

Prof. Rudolf Müller

Language:

DE

Cycle:

SS

Content:

1. The molecular logic of Life
2. Biomolecules:
   1. Amino acids, peptides, proteins
   2. Carbohydrates
   3. Lipids
3. Protein functions, Enzymes:
   1. Michaelis-Menten kinetics
   2. Enzyme regulation
   3. Enzyme nomenclature
4. Cofactors and cosubstrates, vitamines
5. Metabolism:
   1. Basic principles
   2. Photosynthesis
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Course: Microbiology (Vorlesung)

Lecturer:

Dr. Kerstin Sahm, Prof. Garabed Antranikian

Language:

DE

Cycle:

SS

Content:

1. The procaryotic cell

- evolution
- taxonomy and specific properties of Archaea, Bacteria, and viruses
- structure and properties of the cell
- growth

2. Metabolism

- fermentation and anaerobic respiration
- methanogenesis and the anaerobic food chain
- degradation of polymers
- chemolithotrophy

3. Microorganisms in relation to the environment

- chemotaxis and motility
- Elemental cycle of carbon, nitrogen and sulfur
- biofilms
- symbiotic relationships
- extremophiles
- biotechnology

Literature:

• **Allgemeine Mikrobiologie**, 8. Aufl., 2007, Fuchs, G. (Hrsg.), Thieme Verlag (54,95 €)
• **Mikrobiologie**, 13 Aufl., 2013, Madigan, M., Martinko, J. M., Stahl, D. A., Clark, D. P. (Hrsg.), ehemals „Brock“, Pearson Verlag (89,95 €)
• Taschenlehrbuch Biologie **Mikrobiologie**, 2008, Munk, K. (Hrsg.), Thieme Verlag
• **Grundlagen der Mikrobiologie**, 4. Aufl., 2010, Cypionka, H., Springer Verlag (29,95 €), http://www.grundlagen-der-mikrobiologie.icbm.de/

Course: Microbiology (Problemorientierte Lehrveranstaltung)

Lecturer:
Dr. Kerstin Sahm

Language:
DE

Cycle:
SS

Content:
1. The procaryotic cell

- evolution
- taxonomy and specific properties of Archaea, Bacteria, and viruses
- structure and properties of the cell
- growth

2. Metabolism

- fermentation and anaerobic respiration
- methanogenesis and the anaerobic food chain
- degradation of polymers
- chemolithotrophy

3. Microorganisms in relation to the environment

- chemotaxis and motility
- Elemental cycle of carbon, nitrogen and sulfur
- biofilms
- symbiotic relationships
- extremophiles
- biotechnology

Literature:

• **Allgemeine Mikrobiologie**, 8. Aufl., 2007, Fuchs, G. (Hrsg.), Thieme Verlag (54,95 €)
• **Mikrobiologie**, 13 Aufl., 2013, Madigan, M., Martinko, J. M., Stahl, D. A., Clark, D. P. (Hrsg.), ehemals „Brock“, Pearson Verlag (89,95 €)
• Taschenlehrbuch Biologie **Mikrobiologie**, 2008, Munk, K. (Hrsg.), Thieme Verlag
• **Grundlagen der Mikrobiologie**, 4. Aufl., 2010, Cypionka, H., Springer Verlag (29,95 €), http://www.grundlagen-der-mikrobiologie.icbm.de/

Courses:

Title	Typ	Hrs/wk
Introduction to Management	Vorlesung	4
Project Entrepreneurship	Problemorientierte Lehrveranstaltung	2

Module Responsibility:
Prof. Kathrin Fischer

Admission Requirements:
None

Recommended Previous Knowledge:
Basic Knowledge of Mathematics and Business

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
After taking this module, students know the important basics of many different areas in Business and Management, from Planning and Organisation to Marketing and Innovation, and also to Investment and Controlling. In particular they are able to

- explain the differences between Economics and Management and the sub-disciplines in Management and to name important definitions from the field of Management
- explain the most important aspects of and goals in Management and name the most important aspects of entreprneurial projects
- describe and explain basic business functions as production, procurement and sourcing, supply chain management, organization and human ressource management, information management, innovation management and marketing
- explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives and uncertainty, and explain some basic methods from mathematical Finance
- state basics from accounting and costing and selected controlling methods.

Capabilities:
Students are able to analyse business units with respect to different criteria (organization, objectives, strategies etc.) and to carry out an Entrepreneurship project in a team. In particular, they are able to

- analyse Management goals and structure them appropriately
- analyse organisational and staff structures of companies
- apply methods for decision making under multiple objectives, under uncertainty and under risk
- analyse production and procurement systems and Business information systems
- analyse and apply basic methods of marketing
- select and apply basic methods from mathematical finance to predefined problems
- apply basic methods from accounting, costing and controlling to predefined problems

Personal Competence:
Social Competence:
Students are able to

- work successfully in a team of students
- to apply their knowledge from the lecture to an entrepreneurship project and write a coherent report on the project
- to communicate appropriately and
- to cooperate respectfully with their fellow students.

Autonomy:
Students are able to

- work in a team and to organize the team themselves
- to write a report on their project.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 96, Study Time in Lecture: 84

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Electrical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Computer Science and Engineering: Compulsory
General Engineering Science (German program): Vertiefung Chemical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Bioprocess Engineering: Compulsory

General Engineering Science (German program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (German program): Vertiefung Civil- and Enviromental Engeneering: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Naval Architecture: Compulsory
Civil- and Environmental Engeneering: Kernqualifikation: Compulsory
Bioprocess Engineering: Kernqualifikation: Compulsory
Computer Science: Kernqualifikation: Compulsory
Electrical Engineering: Kernqualifikation: Compulsory
Electrical Engineering myTrack: Kernqualifikation: Compulsory
Energy and Environmental Engineering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Civil- and Enviromental Engeneering: Compulsory
General Engineering Science (English program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (English program): Vertiefung Electrical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (English program): Vertiefung Computer Science and Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Naval Architecture: Compulsory
General Engineering Science (English program): Vertiefung Chemical Engineering: Compulsory
Computational Science and Engineering: Kernqualifikation: Compulsory
Logistics and Mobility: Kernqualifikation: Compulsory
Mechanical Engineering: Kernqualifikation: Compulsory
Mechatronics: Kernqualifikation: Compulsory
Naval Architecture: Kernqualifikation: Compulsory
Technomathematics: Kernqualifikation: Compulsory
Process Engineering: Kernqualifikation: Compulsory

Course: Introduction to Management (Vorlesung)

Lecturer:
Prof. Kathrin Fischer, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Cornelius Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona

Language:
DE

Cycle:
WS/SS

Content:

- Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management
- Important definitions from Management,
- Developing Objectives for Business, and their relation to important Business functions
- Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supply Chain Management, Innovation Management, Marketing and Sales
  Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management
- Definitions as information, information systems, aspects of data security and strategic information systems
- Definition and Relevance of innovations, e.g. innovation opporunities, risks etc.
- Relevance of marketing, B2B vs. B2C-Marketing
- different techniques from the field of marketing (e.g. scenario technique), pricing strategies
- important organizational structures
- basics of human ressource management
- Introduction to Business Planning and the steps of a planning process
- Decision Analysis: Elements of decision problems and methods for solving decision problems
- Selected Planning Tasks, e.g. Investment and Financial Decisions
- Introduction to Accounting: Accounting, Balance-Sheets, Costing
- Relevance of Controlling and selected Controlling methods
- Important aspects of Entrepreneurship projects

Literature:
Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008
Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003
Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006.
Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001.
Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgart 2008.
Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeine Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005.
Weber, J., Schäffer, U. : Einführung in das Controlling, 12. Auflage, Stuttgart 2008.
Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006.

Course: Project Entrepreneurship (Problemorientierte Lehrveranstaltung)

Lecturer:
Prof. Christoph Ihl

Language:
DE

Cycle:
WS/SS

Content:
In this project module, students work on an Entrepreneurship project. They are required to go through all relevant steps, from the first idea to the concept, using their knowledge from the corresponding lecture.
Project work is carried out in teams with the support of a mentor.

Literature:
Relevante Literatur aus der korrespondierenden Vorlesung.

Module: Bioprocess Engineering - Fundamentals

Courses:

Title	Typ	Hrs/wk
Bioprocess Engineering - Fundamentals	Vorlesung	2
Bioprocess Engineering- Fundamentals	Hörsaalübung	2
Bioprocess Engineering - Fundamental Practical Course	Laborpraktikum	2

Module Responsibility:
Prof. Andreas Liese

Admission Requirements:
none

Recommended Previous Knowledge:
none, module "organic chemistry", module "fundamentals for process engineering"

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students are able to describe the basic concepts of bioprocess engineering. They are able to classify different types of kinetics for enzymes and microorganisms, as well as to differentiate different types of inhibition. The parameters of stoichiometry and rheology can be named and mass transport processes in bioreactors can be explained. The students are capable to explain fundamental bioprocess management, sterilization technology and downstream processing in detail.
Capabilities:
After successful completion of this module, students should be able to

- describe different kinetic approaches for growth and substrate-uptake and to calculate the corresponding parameters
- predict qualitatively the influence of energy generation, regeneration of redox equivalents and growth inhibition on the fermentation process
- analyze bioprocesses on basis of stoichiometry and to set up / solve metabolic flux equations
- distinguish between scale-up criteria for different bioreactors and bioprocesses (anaerobic, aerobic as well as microaerobic) to compare them as well as to apply them to current biotechnical problem
- propose solutions to complicated biotechnological problems and to deduce the corresponding models

- to explore new knowledge resources and to apply the newly gained contents
- identify scientific problems with concrete industrial use and to formulate solutions.

Personal Competence:
Social Competence:
After completion of this module participants should be able to debate technical questions in small teams to enhance the ability to take position to their own opinions and increase their capacity for teamwork in engineering and scientific environments.
Autonomy:
After completion of this module participants will be able to solve a technical problem in a team independently by organizing their workflow and to present their results in aplenum.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 96, Study Time in Lecture: 84

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Chemical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Bioprocess Engineering: Compulsory
Bioprocess Engineering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (English program): Vertiefung Chemical Engineering: Compulsory
Technomathematics: Vertiefung Engineering Science: Compulsory suffrage
Process Engineering: Kernqualifikation: Compulsory

Course: Bioprocess Engineering - Fundamentals (Vorlesung)

Lecturer:
Prof. Andreas Liese, Prof. An-Ping Zeng

Language:
DE

Cycle:
SS

Content:

- Introduction: state-of-the-art and development trends in the biotechnology, introduction to the lecture
- Enzyme kinetics: Michaelis-Menten, differnt types of enzyme inhibition, linearization, conversion, yield, selectivity (Prof. Liese)
- Stoichiometry: coefficient of respiration, electron balance, degree of reduction, coefficient of yield, theoretical oxygen demand (Prof. Liese)
- Microbial growth kinetic: batch- and chemostat culture (Prof. Zeng)
- Kinetic of subtrate consumption and product formation (Prof. Zeng)
- Rheology: non-newtonian fluids, viscosity, agitators, energy input (Prof. Liese)
- Transport process in a bioreactor (Prof. Zeng)
- Technology of sterilization (Prof. Zeng)
- Fundamentals of bioprocess management: bioreactors and calculation of batch, fed-batch and continuouse bioprocesses (Prof. Zeng/Prof. Liese)
- Downstream technology in biotechnology: cell breakdown, zentrifugation, filtration, aqueous two phase systems (Prof. Liese)

Literature:
K. Buchholz, V. Kasche, U. Bornscheuer: Biocatalysts and Enzyme Technology, 2. Aufl. Wiley-VCH, 2012
H. Chmiel: Bioprozeßtechnik, Elsevier, 2006
R.H. Balz et al.: Manual of Industrial Microbiology and Biotechnology, 3. edition, ASM Press, 2010
H.W. Blanch, D. Clark: Biochemical Engineering, Taylor & Francis, 1997
P. M. Doran: Bioprocess Engineering Principles, 2. edition, Academic Press, 2013

Course: Bioprocess Engineering- Fundamentals (Übung)

Lecturer:
Prof. Andreas Liese, Prof. An-Ping Zeng

Language:
DE

Cycle:
SS

Content:
1. Introduction (Prof. Liese, Prof. Zeng)
2. Enzymatic kinetics (Prof. Liese)
3. Stoichiometry I + II (Prof. Liese)
4. Microbial Kinetics I+II (Prof. Zeng)
5. Rheology (Prof. Liese)
6. Mass transfer in bioprocess (Prof. Zeng)
7. Continuous culture (Chemostat) (Prof. Zeng)
8. Sterilisation (Prof. Zeng)
9. Downstream processing (Prof. Liese)
10. Repetition (Reserve) (Prof. Liese, Prof. Zeng)

Literature:
siehe Vorlesung

Course: Bioprocess Engineering - Fundamental Practical Course (Laborpraktikum)

Lecturer:
Prof. Andreas Liese, Prof. An-Ping Zeng

Language:
DE

Cycle:
SS

Content:
In this course fermentation and downstream technologies on the example of the production of an enzyme by means of a recombinant microorganism is learned. Detailed characterization and simulation of enzyme kinetics as well as application of the enzyme in a bioreactor is carried out.

Literature:
Skript

Courses:

Title	Typ	Hrs/wk
Heat and Mass Transfer	Vorlesung	2
Heat and Mass Transfer	Gruppenübung	1

Module Responsibility:
Prof. Irina Smirnova

Admission Requirements:

Recommended Previous Knowledge:
Basic knowledge: Technical Thermodynamics

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:

- The students are capable of explaining qualitative and determining quantitative heat transfer in procedural apparatus (e. g. heat exchanger, chemical reactors).
- They are capable of distinguish and characterize different kinds of heat transfer mechanisms namely heat conduction, heat transfer and thermal radiation.
- The students have the ability to explain the physical basis for mass transfer in detail and to describe mass transfer qualitative and quantitative by using suitable mass transfer theories.
- They are able to depict the analogy between heat- and mass transfer and to describe complex linked processes in detail.

Capabilities:

- The students are able to set reasonable system boundaries for a given transport problem by using the gained knowledge and to balance the corresponding energy and mass flow, respectively.
- They are capable to solve specific heat transfer problems (e.g. heated chemical reactors, temperature alteration in fluids) and to calculate the corresponding heat flows.
- Using dimensionless quantities, the students can execute scaling up of technical processes or apparatus.
- They are able to distinguish between diffusion, convective mass transition and mass transfer. They can use this knowledge for the description and design of apparatus (e.g. extraction column, rectification column).
- In this context, the students are capable to choose and design fundamental types of heat and mass exchanger for a specific application considering their advantages and disadvantages, respectively.
- In addition, they can calculate both, steady-state and non-steady-state processes in procedural apparatus.
- The students are capable to connect their knowledge obtained in this course with knowlegde of other courses (In particular the courses thermodynamics, fluid mechanics and chemical process engineering) to solve concrete technical problems.

Personal Competence:
Social Competence:

- The students are capable to work on subject-specific challenges in teams and to present the results in a reasonable manner.

Autonomy:

- The students are able to find and evaluate necessary information from suitable sources
- They are able to prove their level of knowledge during the course with accompanying procedure continuously (clicker-system, exam-like assignments) and on this basis they can control their learning processes.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 138, Study Time in Lecture: 42

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Chemical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (German program): Vertiefung Energy and Enviromental Engineering: Compulsory

Bioprocess Engineering: Kernqualifikation: Compulsory
Energy and Environmental Engineering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (English program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (English program): Vertiefung Chemical Engineering: Compulsory
Technomathematics: Kernqualifikation: Compulsory suffrage
Process Engineering: Kernqualifikation: Compulsory

Course: Heat and Mass Transfer (Vorlesung)

Lecturer:
Prof. Irina Smirnova

Language:
DE

Cycle:
WS

Content:

1. Heat transfer
    - Introduction, one-dimensional heat conduction
    - Convective heat transfer
    - Multidimensional heat conduction
    - Non-steady heat conduction
    - Thermal radiation
2. Mass transfer
    - one-way diffusion, equimolar countercurrent diffusion
    - boundary layer theory, non-steady mass transfer
    - Heat and mass transfer single particle/ fixed bed
    - Mass transfer and chemical reactions

Literature:

1. H.D. Baehr und K. Stephan: Wärme- und Stoffübertragung, Springer
2. VDI-Wärmeatlas

Course: Heat and Mass Transfer (Übung)

Lecturer:
Prof. Irina Smirnova

Language:
DE

Cycle:
WS

Content:

1. Heat transfer
    - Introduction, one-dimensional heat conduction
    - Convective heat transfer
    - Multidimensional heat conduction
    - Non-steady heat conduction
    - Thermal radiation
2. Mass transfer
    - one-way diffusion, equimolar countercurrent diffusion
    - boundary layer theory, non-steady mass transfer
    - Heat and mass transfer single particle/ fixed bed
    - Mass transfer and chemical reactions

Literature:

1. H.D. Baehr und K. Stephan: Wärme- und Stoffübertragung, Springer
2. VDI-Wärmeatlas

Courses:

Title	Typ	Hrs/wk
Thermal Separation Processes	Vorlesung	3
Thermal Separation Processes	Gruppenübung	2
Thermal Separation Processes	Hörsaalübung	1
Separation Processes	Laborpraktikum	1

Module Responsibility:
Prof. Irina Smirnova

Admission Requirements:
Recommended requirements: Thermodynamics III (not compulsory)

Recommended Previous Knowledge:
Recommended requirements: Thermodynamics III

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:

- The students develop an understanding of separation processes of fluid mixtures
- They can distinguish and describe different types of separation processes such as distillation, extraction or adsorption
- The students have good knowledge of designing methods for separation processes and devices
- The students develop an understanding for the course of concentration changes during a separation process, the estimation of the energy demand of a process, the possibilities of energy saving and the selection of separation systems

Capabilities:

- Using the gained knowledge the students can select a reasonable system boundary for a given separation process and can close the associated energy and material balances
- The students can use different graphical methods for the designing of a separation process and define the amount of theoretical stages required
- They can select and design a basic type of thermal separation process for a given case based on the advantages and disadvantages of the process
- The students are capable to obtain independently the needed material properties from appropriate sources (diagrams and tables)
- They can calculate continuous and discontinuous processes

The students are capable of linking their gained knowledge with the content of other lectures and use it together for the solution of technical problems. Other lectures such as thermodynamics, fluid mechanics and chemical engineering.

Personal Competence:
Social Competence:

- The students can work technical assignments in small groups and present the combined results in the tutorial

Autonomy:

- The students are capable to obtain the needed information from suitable sources by themselves and assess their quality
- The students can proof the state of their knowledge with exam resembling assignments and in this way control their learning process

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 82, Study Time in Lecture: 98

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Chemical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (German program): Vertiefung Energy and Enviromental Engineering: Compulsory
Bioprocess Engineering: Kernqualifikation: Compulsory

Energy and Environmental Engineering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (English program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (English program): Vertiefung Chemical Engineering: Compulsory
Process Engineering: Kernqualifikation: Compulsory

Course: Thermal Separation Processes (Vorlesung)

Lecturer:
Prof. Irina Smirnova

Language:
DE

Cycle:
WS

Content:

- Introduction in the thermal process engineering and to the main features of separation processes
- Simple equilibrium processes, several steps processes
- Distillation of binary mixtures, enthalpy-concentration diagrams
- Extractive and azeotrope distillation, water vapor distillation, stepwise distillation
- Extraction: separation ternary systems, ternary diagram
- Multiphase separation including complex mixtures
- Designing of separation devices without discrete stages
- Drying
- Chromatographic separation processes
- Membrane separation
- Energy demand of separation processes
- Advance overview of separation processes
- Selection of separation processes

Literature:

- G. Brunner: Skriptum Thermische Verfahrenstechnik
- J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980
- Sattler: Thermische Trennverfahren, VCH, Weinheim 1995
- J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998.
- Mersmann: Thermische Verfahrenstechnik, Springer, 1980
- Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997
- Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1 ; ISBN 0-387-91477-3 .
- R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006.
    - Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed., McGraw-Hill, New York 1984 Ullmann"s Enzyklopädie der Technischen Chemie

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Course: Thermal Separation Processes (Übung)

Lecturer:
Prof. Irina Smirnova

Language:
DE

Cycle:
WS

Content:

- Introduction in the thermal process engineering and to the main features of separation processes
- Simple equilibrium processes, several steps processes
- Distillation of binary mixtures, enthalpy-concentration diagrams
- Extractive and azeotrope distillation, water vapor distillation, stepwise distillation
- Extraction: separation ternary systems, ternary diagram
- Multiphase separation including complex mixtures
- Designing of separation devices without discrete stages
- Drying
- Chromatographic separation processes
- Membrane separation
- Energy demand of separation processes
- Advance overview of separation processes

- Selection of separation processes

Literature:

- G. Brunner: Skriptum Thermische Verfahrenstechnik
- J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980
- Sattler: Thermische Trennverfahren, VCH, Weinheim 1995
- J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998.
- Mersmann: Thermische Verfahrenstechnik, Springer, 1980
- Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997
- Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1 ; ISBN 0-387-91477-3 .
- R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006.
- Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed., McGraw-Hill, New York 1984 Ullmann"s Enzyklopädie der Technischen Chemie

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Course: Thermal Separation Processes (Übung)

Lecturer:
Prof. Irina Smirnova

Language:
DE

Cycle:
WS

Content:

- Introduction in the thermal process engineering and to the main features of separation processes
- Simple equilibrium processes, several steps processes
- Distillation of binary mixtures, enthalpy-concentration diagrams
- Extractive and azeotrope distillation, water vapor distillation, stepwise distillation
- Extraction: separation ternary systems, ternary diagram
- Multiphase separation including complex mixtures
- Designing of separation devices without discrete stages
- Drying
- Chromatographic separation processes
- Membrane separation
- Energy demand of separation processes
- Advance overview of separation processes
- Selection of separation processes

Literature:

- G. Brunner: Skriptum Thermische Verfahrenstechnik
- J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980
- Sattler: Thermische Trennverfahren, VCH, Weinheim 1995
- J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998.
- Mersmann: Thermische Verfahrenstechnik, Springer, 1980
- Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997
- Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1 ; ISBN 0-387-91477-3 .
- R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006.
- Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed., McGraw-Hill, New York 1984 Ullmann"s Enzyklopädie der Technischen Chemie

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Course: Separation Processes (Laborpraktikum)

Lecturer:
Prof. Irina Smirnova

Language:
DE/EN

Cycle:
SS

Content:

- Introduction in the thermal process engineering and to the main features of separation processes
- Simple equilibrium processes, several steps processes
- Distillation of binary mixtures, enthalpy-concentration diagrams
- Extractive and azeotrope distillation, water vapor distillation, stepwise distillation
- Extraction: separation ternary systems, ternary diagram
- Multiphase separation including complex mixtures
- Designing of separation devices without discrete stages
- Drying
- Chromatographic separation processes
- Membrane separation
- Energy demand of separation processes
- Advance overview of separation processes
- Selection of separation processes

Literature:

- G. Brunner: Skriptum Thermische Verfahrenstechnik
- J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980
- Sattler: Thermische Trennverfahren, VCH, Weinheim 1995
- J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998.
- Mersmann: Thermische Verfahrenstechnik, Springer, 1980
- Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997
- Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1 ; ISBN 0-387-91477-3 .
- R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006.
- Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed., McGraw-Hill, New York 1984 Ullmann"s Enzyklopädie der Technischen Chemie

Module: Chemical Reaction Engineering

Courses:

Title	Typ	Hrs/wk
Chemical Reaction Engineering (Fundamentals)	Vorlesung	2
Chemical Reaction Engineering (Fundamentals)	Hörsaalübung	2
Experimental Course Chemical Engineering (Fundamentals)	Laborpraktikum	2

Module Responsibility:
Prof. Raimund Horn

Admission Requirements:
Not applicable

Recommended Previous Knowledge:
Contents of the previous modules mathematics I-III, physical chemistry, technical thermodynamics I+II as well as computational methods for engineers.

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students are able to explain basic concepts of chemical reaction engineering. They are able to point out differences between thermodynamical and kinetical processes. The students have a strong ability to outline parts of isothermal and non-isothermal ideal reactors and to describe their properties.
Capabilities:
After successful completion of the module, students are able to:
- apply different computational methods to dimension isothermal and non-isothermal ideal reactors,
- determine and compute stable operation points for these reactors ,
- conduct experiments on a lab-scale pilot plants and document these according to scientific guidelines.

Personal Competence:
Social Competence:
After successful completition of the lab-course the students have a strong ability to organize themselfes in small groups to solve issues in chemical reaction engineering.
Autonomy:
The students are able to obtain further information and assess their relevance autonomously. Students can apply their knowldege discretely to plan, prepare and conduct experiments.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 96, Study Time in Lecture: 84

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Chemical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Bioprocess Engineering: Compulsory
Bioprocess Engineering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (English program): Vertiefung Chemical Engineering: Compulsory
Process Engineering: Kernqualifikation: Compulsory

Course: Chemical Reaction Engineering (Fundamentals) (Vorlesung)

Lecturer:
Prof. Raimund Horn

Language:
DE

Cycle:
WS

Content:
Fundamentals of chemical reaction engineering, definitions, calculation of species concentrations (reactor, reaction mixture, reactants, products, inerts and solvents, reaction volume, Reaktor volume, chemical reaction, mass, moles, mole fraction, volume, density, molar concentration, mass-concentration, molality, partial pressure, hydrodynamic residence time, space time, extent of reaction, reactor throughput, reactor load, conversion, selectivity, yield, concentration calculations in stationary and flowing multicomponent-mixtures) Stoichiometry and stoichiometric calculations (simple reactions, complex reactions, key reactions, key species, matrix of stoichiometric coefficients, linear dependent and independent reactions, element-species-matrix, row reduced form of a matrix, rank of a matrix, Gauss

Jordan elimination, relation between stoichiometry and kinetics, calculating the extent of reaction from mole number changes in complex reactions)
Thermodynamics (What is thermodynamics?, importance of thermodynamics in chemical reaction engineering, zeroth law of thermodynamics, temperature scales, temperature measurements in praxis, first law of thermodynamics, internal energy, enthalpy, calorimeter, heat of reaction, standard heat of formation, Hess law, heat capacity, Kirchhoff law, standard heat of reaction, pressure dependence of the heat of reaction, second law of thermodynamics, reversible and irreversible processes, entropy, Clausius inequality, free energy, Gibbs Energy, chemical potential, chemical equilibrium, activity, van't Hoff law, calculation of chemical equilibrium, principle of Le Chatelier and Braun, equilibrium calculations in multiple reaction systems, Lagrange Multipliers)
Chemical kinetics (reversible and irreversible reactions, homogeneous and heterogeneous reactions, elementary step, reaction mechanism, microkinetics, macrokinetics, formal kinetics, reaction rate, rate of change of species mole number, Arrhenius-equation, activation energy and pre-exponential factor for komplex reactions, reactions of 0., 1. and 2. order, analytical integration of rate laws, Damköhler-number, differential and integral method of kinetic analysis, laboratory reactors for kinetic measurements, half life, kinetics of complex reactions, parallel reactions, reversible reactions, sequence of reactions, irreversible reaction with pre-equilibrium, reduction of reaction mechanisms, quasi-stationarity principle of Bodenstein, rate limiting step, Michaelis-Menten kinetics, analytical integration of first order differential equations - integrating factor, numerical integration of complex kinetics)
Types of chemical Reaktors (chemical reactors in industry and laboratory, ideal vs. real reaktors, discontinuous, half continuous and continuous reactors, single phase - biphasic- and multiphase reactors, batch-reactor, semi-batch reactor, CSTR, Plug Flow reactor, fixed bed reactor, adiabatic staged reactors, rotating furnaces, fluidized bed reactors, gas-liquid-reactors, multi-phase reactors)
Isothermal ideal reactors (mole-balance of a chemical reactor, mole balance of a batch reactor, integration of the batch reactor mole balance for various kinetics, partial fraction decomposition, mole balance of the semi-batch reactor, mole balance of the plug flow reactor, analogy batch reactor - plug flow reactor, design of plug flow reactors for reactions with volume change and complex reactions, mole balance of a fixed bed reactor, design of a membrane reactor, mole balance of a continuously stirred tank reactor, comparison of CSTR and PFR with respect to conversion and selectivity, mole-balance of a cascade of tank reactors, numerical-interative calculation of a cascade of tank reactors, Newton-Raphson method, graphical analysis of a cascade of tank reactors)
non-isothermal ideal reactors (energy balance of a reactor, adiabatic reactor, adiabatic temperature rise, staged reactor for adiabatic exothermic reactions limited by chemical equilibrium, design of an adiabatic plug flow reactor, Levenspiel-plots, heat transfer through a reactor wall, heat transfer by convection, heat conduction, heat transfer through a cylindrical wall, design of a plug flow reactor in parallel and counter flow, heat balance of the cooling fluid, CSTR with heat exchange, multiple stationary states, ignition-extinction behavior, stability of a CSTR, complex reactions in non-isothermal reactors, optimum temperature profile of a reactor)

Literature:

lecture notes Raimund Horn
skript Frerich Keil
Books:
M. Baerns, A. Behr, A. Brehm, J. Gmehling, H. Hofmann, U. Onken, A. Renken, Technische Chemie, Wiley-VCH
G. Emig, E. Klemm, Technische Chemie, Springer
A. Behr, D. W. Agar, J. Jörissen, Einführung in die Technische Chemie
E. Müller-Erlwein, Chemische Reaktionstechnik 2012, 2. Auflage, Teubner Verlag
J. Hagen, Chemiereaktoren: Auslegung und Simulation, 2004, Wiley-VCH
H. S. Fogler, Elements of Chemical Reaction Engineering, Prentice Hall B
H. S. Fogler, Essentials of Chemical Reaction Engineering, Prentice Hall
O. Levenspiel, Chemical Reaction Engineering, John Wiley & Sons, 1998
L. D. Schmidt, The Engineering of Chemical Reactions, Oxford Univ. Press, 2009
J. B. Butt, Reaction Kinetics and Reactor Design, 2000, Marcel Dekker
R. Aris, Elementary Chemical Reactor Analysis, Dover Pubn. Inc., 2000
M. E. Davis, R. J. Davis, Fundamentals of Chemical Reaction Engineering, McGraw Hill
G. F. Froment, K. B. Bischoff, J. De Wilde, Chemical Reactor Analysis and Design, John Wiley & Sons, 2010
A. Jess, P. Wasserscheid, Chemical Technology An Integrated Textbook, WILEY-VCH

Course: Chemical Reaction Engineering (Fundamentals) (Übung)

Lecturer:

Prof. Raimund Horn

Language:

DE

Cycle:

WS

Content:

Fundamentals of chemical reaction engineering, definitions, calculation of species concentrations (reactor, reaction mixture, reactants, products, inerts and solvents, reaction volume, Reaktor volume, chemical reaction, mass, moles, mole fraction, volume, density, molar concentration, mass-concentration, molality, partial pressure, hydrodynamic residence time, space time, extent of reaction, reactor throughput, reactor load, conversion, selectivity, yield, concentration calculations in stationary and flowing multicomponent-mixtures)
Stoichiometry and stoichiometric calculations (simple reactions, complex reactions, key reactions, key species, matrix of stoichiometric coefficients, linear dependent and independent reactions, element-species-matrix, row reduced form of a matrix, rank of a matrix, Gauss Jordan elimination, relation between stoichiometry and kinetics, calculating the extent of reaction from mole number changes in complex reactions)
Thermodynamics (What is thermodynamics?, importance of thermodynamics in chemical reaction engineering, zeroth law of thermodynamics, temperature scales, temperature measurements in praxis, first law of thermodynamics, internal energy, enthalpy, calorimeter, heat of reaction, standard heat of formation, Hess law, heat capacity, Kirchhoff law, standard heat of reaction, pressure

dependence of the heat of reaction, second law of thermodynamics, reversible and irreversible processes, entropy, Clausius inequality, free energy, Gibbs Energy, chemical potential, chemical equilibrium, activity, van't Hoff law, calculation of chemical equilibrium, principle of Le Chatelier and Braun, equilibrium calculations in multiple reaction systems, Lagrange Multipliers)
Chemical kinetics (reversible and irreversible reactions, homogeneous and heterogeneous reactions, elementary step, reaction mechanism, microkinetics, macrokinetics, formal kinetics, reaction rate, rate of change of species mole number, Arrhenius-equation, activation energy and pre-exponential factor for komplex reactions, reactions of 0., 1. and 2. order, analytical integration of rate laws, Damköhler-number, differential and integral method of kinetic analysis, laboratory reactors for kinetic measurements, half life, kinetics of complex reactions, parallel reactions, reversible reactions, sequence of reactions, irreversible reaction with pre-equilibrium, reduction of reaction mechanisms, quasi-stationarity principle of Bodenstein, rate limiting step, Michaelis-Menten kinetics, analytical integration of first order differential equations - integrating factor, numerical integration of complex kinetics)
Types of chemical Reaktors (chemical reactors in industry and laboratory, ideal vs. real reaktors, discontinuous, half continuous and continuous reactors, single phase - biphasic- and multiphase reactors, batch-reactor, semi-batch reactor, CSTR, Plug Flow reactor, fixed bed reactor, adiabatic staged reactors, rotating furnaces, fluidized bed reactors, gas-liquid-reactors, multi-phase reactors)
Isothermal ideal reactors (mole-balance of a chemical reactor, mole balance of a batch reactor, integration of the batch reactor mole balance for various kinetics, partial fraction decomposition, mole balance of the semi-batch reactor, mole balance of the plug flow reactor, analogy batch reactor - plug flow reactor, design of plug flow reactors for reactions with volume change and complex reactions, mole balance of a fixed bed reactor, design of a membrane reactor, mole balance of a continuously stirred tank reactor, comparison of CSTR and PFR with respect to conversion and selectivity, mole-balance of a cascade of tank reactors, numerical-interative calculation of a cascade of tank reactors, Newton-Raphson method, graphical analysis of a cascade of tank reactors)
non-isothermal ideal reactors (energy balance of a reactor, adiabatic reactor, adiabatic temperature rise, staged reactor for adiabatic exothermic reactions limited by chemical equilibrium, design of an adiabatic plug flow reactor, Levenspiel-plots, heat transfer through a reactor wall, heat transfer by convection, heat conduction, heat transfer through a cylindrical wall, design of a plug flow reactor in parallel and counter flow, heat balance of the cooling fluid, CSTR with heat exchange, multiple stationary states, ignition-extinction behavior, stability of a CSTR, complex reactions in non-isothermal reactors, optimum temperature profile of a reactor)

Literature:

lecture notes Raimund Horn
skript Frerich Keil
Books:
M. Baerns, A. Behr, A. Brehm, J. Gmehling, H. Hofmann, U. Onken, A. Renken, Technische Chemie, Wiley-VCH
G. Emig, E. Klemm, Technische Chemie, Springer
A. Behr, D. W. Agar, J. Jörissen, Einführung in die Technische Chemie
E. Müller-Erlwein, Chemische Reaktionstechnik 2012, 2. Auflage, Teubner Verlag
J. Hagen, Chemiereaktoren: Auslegung und Simulation, 2004, Wiley-VCH
H. S. Fogler, Elements of Chemical Reaction Engineering, Prentice Hall B
H. S. Fogler, Essentials of Chemical Reaction Engineering, Prentice Hall
O. Levenspiel, Chemical Reaction Engineering, John Wiley & Sons, 1998
L. D. Schmidt, The Engineering of Chemical Reactions, Oxford Univ. Press, 2009
J. B. Butt, Reaction Kinetics and Reactor Design, 2000, Marcel Dekker
R. Aris, Elementary Chemical Reactor Analysis, Dover Pubn. Inc., 2000
M. E. Davis, R. J. Davis, Fundamentals of Chemical Reaction Engineering, McGraw Hill
G. F. Froment, K. B. Bischoff, J. De Wilde, Chemical Reactor Analysis and Design, John Wiley & Sons, 2010
A. Jess, P. Wasserscheid, Chemical Technology An Integrated Textbook, WILEY-VCH

Course: Experimental Course Chemical Engineering (Fundamentals) (Laborpraktikum)

Lecturer:

Prof. Raimund Horn, Dr. Achim Bartsch

Language:

DE/EN

Cycle:

SS

Content:

Performing and evaluation of experiments concerning chemical reaction engineering with emphasis on ideal reactors:
* Batch reactor - Estimation of kinetic parameters for the saponification of ethylacetate
*CSTR - Residence time distribution, reaction
*CSTR in Series - Residence time distribution, reaction
* Plug Flow Reactor - Residence time distribution, reaction

Literature:

Levenspiel, O.: Chemical reaction engineering; John Wiley & Sons, New York, 3. Ed., 1999 VTM 309(LB)
Praktikumsskript
Skript Chemische Verfahrenstechnik 1 (F.Keil)

Courses:

Title	Typ	Hrs/wk
Bioprocess Engineering - Advanced	Vorlesung	2
Bioprocess Engineering - Advanced	Gruppenübung	2

Module Responsibility:
Prof. An-Ping Zeng

Admission Requirements:
none

Recommended Previous Knowledge:
Content of module "Biochemical Engineering I"

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
After successful completion of this module, students should be able to

- describe and explain different kinetic approaches for growth and substrate-uptake
- identification of scientific problems with concrete industrial use (cultivation of microorganisms and mammalian cells)
- describe and explain important downstreaming steps for proteins and their application as well as basic immobilization methods

Capabilities:
After successful completion of this module, students should be able to
- to identifiy scientific questions or possible practical problems for concrete industrial applications (eg cultivation of microorganisms and animal cells) and to formulate solutions ,

- To assess the application of scale-up criteria for different types of bioreactors and processes and to apply these criteria to given problems (anaerobic , aerobic or microaerobically)

- to formulate questions for the analysis and optimization of real biotechnological production processes appropriate solutions ,

- To describe the effects of the energy generation, the regeneration of reduction equivalents , and the growth inhibition of the behavior of microorganisms and to the total fermentation process qualitatively

- Establish material flow balance equations and solve them to determine the kinetic parameters of different approaches and to calculate immobilization and activity yields ,

- to select process control strategies (batch , fed-batch , continuity) appropriately and to calculate basic types and evaluate them.

Personal Competence:
Social Competence:
After completion of this module participants should be able to debate technical questions in small teams to enhance the ability to take position to their own opinions and increase their capacity for teamwork.

Autonomy:
After completion of this module participants are able to aquire new sources of knowledge and apply their knowledge to previously unknown issues and to present these.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Bioprocess Engineering: Compulsory
Bioprocess Engineering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Bioprocess Engineering: Compulsory
Technomathematics: Kernqualifikation: Compulsory suffrage

Course: Bioprocess Engineering - Advanced (Vorlesung)

Lecturer:
Prof. An-Ping Zeng, Prof. Andreas Liese

Language:
DE

Cycle:
WS

Content:

- Introduction: state-of-the-art and development trends of microbial and biocatalytic bioprocesses, introduction to the lecture
- Enzymatic process I: reactor types and criteria for industrial biotransformations (Prof. Liese)
- Enzymatic process II (Prof. Liese)
- Immobilization technologies: basic methods for isoltaed enzymes/ cells (Prof. Liese)
- Anaerobic fermentation processes (Prof. Zeng)
- Microaerobic bioprocesses: kinetics, energetics, optimal O2-supply and scale-up (Prof. Zeng)
- Fedbatch process and cultivation with high cell density (Prof. Zeng)
- Downstream processing of protein bioproduction: basics of chromatography, membrane filtration (Prof. Liese)
- Cell culture technology and continuous culture: basics, kinetics, media, reactors (Prof. Zeng)
- Problem-based learning with selected bioprocesses (Prof. Liese, Prof. Zeng)

Literature:
K. Buchholz, V. Kasche, U. Bornscheuer: Biocatalysts and Enzyme Technology, 2. Aufl. Wiley-VCH, 2012
H. Chmiel: Bioprozeßtechnik, Elsevier, 2006
R.H. Balz et al.: Manual of Industrial Microbiology and Biotechnology, 3. edition, ASM Press, 2010
H.W. Blanch, D. Clark: Biochemical Engineering, Taylor & Francis, 1997
P. M. Doran: Bioprocess Engineering Principles, 2. edition, Academic Press, 2013

Skripte für die Vorlesung

Course: Bioprocess Engineering - Advanced (Übung)

Lecturer:
Prof. An-Ping Zeng, Prof. Andreas Liese

Language:
DE

Cycle:
WS

Content:

- Introduction: state-of-the-art and development trends of microbial and biocatalytic bioprocesses, introduction to the lecture
- Enzymatic process I: reactor types and criteria for industrial biotransformations (Prof. Liese)
- Enzymatic process II (Prof. Liese)
- Immobilization technologies: basic methods for isoltaed enzymes/ cells (Prof. Liese)
- Anaerobic fermentation processes (Prof. Zeng)
- Microaerobic bioprocesses: kinetics, energetics, optimal O2-supply and scale-up (Prof. Zeng)
- Fedbatch process and cultivation with high cell density (Prof. Zeng)
- Downstream processing of protein bioproduction: basics of chromatography, membrane filtration (Prof. Liese)
- Cell culture technology and continuous culture: basics, kinetics, media, reactors (Prof. Zeng)
- Problem-based learning with selected bioprocesses (Prof. Liese, Prof. Zeng)

Literature:
K. Buchholz, V. Kasche, U. Bornscheuer: Biocatalysts and Enzyme Technology, 2. Aufl. Wiley-VCH, 2012
H. Chmiel: Bioprozeßtechnik, Elsevier, 2006
R.H. Balz et al.: Manual of Industrial Microbiology and Biotechnology, 3. edition, ASM Press, 2010
H.W. Blanch, D. Clark: Biochemical Engineering, Taylor & Francis, 1997
P. M. Doran: Bioprocess Engineering Principles, 2. edition, Academic Press, 2013

Skripte für die Vorlesung

Module: Process and Plant Engineering I

Courses:

Title	Typ	Hrs/wk
Process and Plant Engineering I	Vorlesung	2
Process and Plant Engineering I	Hörsaalübung	1
Process and Plant Engineering I	Gruppenübung	1

Module Responsibility:
Prof. Georg Fieg

Admission Requirements:
none

Recommended Previous Knowledge:
unit operation of thermal an dmechanical separation processes
chemical reactor eingineering

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
students can:
classify and formulate blobal balance equations of chemical processes
specify linear component equations of complex chemical processes
explain linear regression and data reconcilliation problems
explain pfd-diagrams
Capabilities:
students are capable of
- formulation of mass and energy balance equations and estimation of product streams
- estimation of component streams of chemical plants using linear component balance models
- solution of data reconcilliation tasks
- conduction of process synthesis
- economic evaluation of processes and the estimation of production costs

Personal Competence:
Social Competence:
Autonomy:

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Chemical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Bioprocess Engineering: Compulsory
Bioprocess Engineering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (English program): Vertiefung Chemical Engineering: Compulsory
Process Engineering: Kernqualifikation: Compulsory

Course: Process and Plant Engineering I (Vorlesung)

Lecturer:
Prof. Georg Fieg

Language:
DE

Cycle:
SS

Content:

1. **Introduction**
   Structure and operation of production plants
   Operational business process
   Technical process design
   Motivation and targets of process development

Life cycle of production plants

2. **Engineering methods and tools**
   Mass and energy balances
   Strategies of process synthesis
   Graphical representation of processes
   Multidimensional regression
   Data reconciliation and data validation
3. **Process Synthesis**
   Decision levels
   Experimental process development
   Reactor synthesis
   Synthesis of separation processes (process alternatives and criteria for selection)
   Integration of reaction systems/separation systems (interactions, recycle streams)
4. **Process safety**
5. **Cost estimation of production plants**
   Production costs, capital costs, economic evaluation

Literature:

S.D. Barnicki, J.R. Fair, Ind. End. Chem., 29(1990), S. 421, Ind. End. Chem., 31(1992), S. 1679
H. Becker, S. Godorr, H. Kreis, Chemical Engineering, January 2001, S. 68-74
Behr, W. Ebbers, N. Wiese, Chem. -Ing.-Tech. 72(2000)Nr. 10, S.1157
E. Blass, Entwicklung verfahrenstechnischer Prozesse, Springer-Verlag, 2. Auflage 1997
M. H. Bauer, J. Stichlmair, Chem.-Ing.-Tech., 68(1996), Nr. 8, 911-916
R. Dittmeyer, W. Keim, G. Kreysa, A. Oberholz, Chemische Technik. Prozesse und Produkte, Band 2, Neue Technologien, 5. Auflage, Wiley-VCH GmbH&Co.KGaA, Weinheim, 2004
J.M. Douglas, Conceptual Design of Chemical Processes, Mc Graw-Hill, NY, 1988
G. Fieg, Inz. Chem. Proc., 5(1979), S.15-19
G. Fieg, G. Wozny, L. Jeromin, Chem. Eng. Technol. 17(1994),5, 301-306
G. Fieg, Heat and Mass Transfer 32(1996), S. 205-213
G. Fieg, Chem. Eng. Processing, Vol. 41/2(2001), S. 123-133
U.H. Felcht, Chemie eine reife Industrie oder weiterhin Innovationsmotor, Universitätsbuchhandlung Blazek und Bergamann, Frankfurt, 2000
J.P. van Gigch, Systems Design, Modeling and Metamodeling, Plenum Press, New York, 1991
T.F. Edgar, D.M. Himmelblau, L.S. Lasdon, Optimization of Chemical Processes, McGraw-Hill, 2001
G. Gruhn, Vorlesungsmanuskript „Prozess- und Anlagentechnik, TU Hamburg-Harburg
D. Hairston, Chemical Engineering, October 2001, S. 31-37
J.L.A. Koolen, Design of Simple and Robust Process Plants, Wiley-VCH, Weinheim, 2002
J. Krekel, G. Siekmann, Chem. -Ing.-Tech. 57(1985)Nr. 6, S. 511
K. Machej, G. Fieg, J. Wojcik, Inz. Chem. Proc., 2(1981), S.815-824
S. Meier, G. Kaibel, Chem. -Ing.-Tech. 62(1990)Nr. 13, S.169
J. Mittelstraß, Chem. -Ing.-Tech. 66(1994), S. 309
P. Li, M. Flender, K. Löwe, G. Wozny, G. Fieg, Fett/Lipid 100(1998), Nr. 12, S. 528-534
G. Kaibel, Dissertation, TU München, 1987
G. Kaibel, Chem.-Ing.-Tech. 61 (1989), Nr. 2, S. 104-112
G. Kaibel, Chem. Eng. Technol., 10(1987), Nr. 2, S. 92-98
H.J. Lang, Chem. Eng. 54(10),117, 1947
H.J. Lang, Chem. Eng. 55(6), 112, 1948
F. Lestak, C. Collins, Chemical Engineering, July 1997, S. 72-76

Course: Process and Plant Engineering I (Übung)

Lecturer:
Prof. Georg Fieg

Language:
DE

Cycle:
SS

Content:

1. **Introduction**
   Structure and operation of production plants
   Operational business process
   Technical process design
   Motivation and targets of process development
   Life cycle of production plants
2. **Engineering methods and tools**
   Mass and energy balances
   Strategies of process synthesis

Graphical representation of processes
Multidimensional regression
Data reconciliation and data validation

3. **Process Synthesis**
   Decision levels
   Experimental process development
   Reactor synthesis
   Synthesis of separation processes (process alternatives and criteria for selection)
   Integration of reaction systems/separation systems (interactions, recycle streams)
4. **Process safety**
5. **Cost estimation of production plants**
   Production costs, capital costs, economic evaluation

Literature:

S.D. Barnicki, J.R. Fair, Ind. End. Chem., 29(1990), S. 421, Ind. End. Chem., 31(1992), S. 1679
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J.M. Douglas, Conceptual Design of Chemical Processes, Mc Graw-Hill, NY, 1988
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H.J. Lang, Chem. Eng. 55(6), 112, 1948
F. Lestak, C. Collins, Chemical Engineering, July 1997, S. 72-76

Course: Process and Plant Engineering I (Übung)

Lecturer:
Prof. Georg Fieg

Language:
DE

Cycle:
SS

Content:

1. **Introduction**
   Structure and operation of production plants
   Operational business process
   Technical process design
   Motivation and targets of process development
   Life cycle of production plants
2. **Engineering methods and tools**
   Mass and energy balances
   Strategies of process synthesis
   Graphical representation of processes
   Multidimensional regression
   Data reconciliation and data validation
3. **Process Synthesis**

Decision levels
Experimental process development
Reactor synthesis
Synthesis of separation processes (process alternatives and criteria for selection)
Integration of reaction systems/separation systems (interactions, recycle streams)

4. **Process safety**
5. **Cost estimation of production plants**
   Production costs, capital costs, economic evaluation

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K. Machej, G. Fieg, J. Wojcik, Inz. Chem. Proc., 2(1981), S.815-824
S. Meier, G. Kaibel, Chem. -Ing.-Tech. 62(1990)Nr. 13, S.169
J. Mittelstraß, Chem. -Ing.-Tech. 66(1994), S. 309
P. Li, M. Flender, K. Löwe, G. Wozny, G. Fieg, Fett/Lipid 100(1998), Nr. 12, S. 528-534
G. Kaibel, Dissertation, TU München, 1987
G. Kaibel, Chem.-Ing.-Tech. 61 (1989), Nr. 2, S. 104-112
G. Kaibel, Chem. Eng. Technol., 10(1987), Nr. 2, S. 92-98
H.J. Lang, Chem. Eng. 54(10),117, 1947
H.J. Lang, Chem. Eng. 55(6), 112, 1948
F. Lestak, C. Collins, Chemical Engineering, July 1997, S. 72-76

Module: Particle Technology and Solids Process Engineering

Courses:

Title	Typ	Hrs/wk
Particle Technology I	Vorlesung	2
Particle Technology I	Gruppenübung	1
Particle Technology I	Laborpraktikum	2

Module Responsibility:
Prof. Stefan Heinrich

Admission Requirements:
-

Recommended Previous Knowledge:

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
After successful completion of the module students are able to

- name and explain processes and unit-operations of solids process engineering,
- characterize particles, particle distributions and to discuss their bulk properties

Capabilities:
Students are able to

- choose and design apparatuses and processes for solids processing according to the desired solids properties of the product
- asses solids with respect to their behavior in solids processing steps

Personal Competence:
Social Competence:
Autonomy:

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 110, Study Time in Lecture: 70

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Chemical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (German program): Vertiefung Energy and Enviromental Engineering: Compulsory
Bioprocess Engineering: Kernqualifikation: Compulsory
Energy and Environmental Engineering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (English program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (English program): Vertiefung Chemical Engineering: Compulsory
Process Engineering: Kernqualifikation: Compulsory

Course: Particle Technology I (Vorlesung)

Lecturer:
Prof. Stefan Heinrich

Language:
DE

Cycle:
SS

Content:

- Description of particles and particle distributions
- Description of a separation process
- Description of a particle mixture
- Particle size reduction
- Agglomeration, particle size enlargement

- Storage and flow of bulk solids
- Basics of fluid/particle flows
- classifying processes
- Separation of particles from fluids
- Basic fluid mechanics of fluidized beds
- Pneumatic and hydraulic transport

Literature:

Schubert, H.; Heidenreich, E.; Liepe, F.; Neeße, T.: Mechanische Verfahrenstechnik. Deutscher Verlag für die Grundstoffindustrie, Leipzig, 1990.
Stieß, M.: Mechanische Verfahrenstechnik I und II. Springer Verlag, Berlin, 1992.

Course: Particle Technology I (Übung)

Lecturer:

Prof. Stefan Heinrich

Language:

DE

Cycle:

SS

Content:

- Description of particles and particle distributions
- Description of a separation process
- Description of a particle mixture
- Particle size reduction
- Agglomeration, particle size enlargement
- Storage and flow of bulk solids
- Basics of fluid/particle flows
- classifying processes
- Separation of particles from fluids
- Basic fluid mechanics of fluidized beds
- Pneumatic and hydraulic transport

Literature:

Schubert, H.; Heidenreich, E.; Liepe, F.; Neeße, T.: Mechanische Verfahrenstechnik. Deutscher Verlag für die Grundstoffindustrie, Leipzig, 1990.
Stieß, M.: Mechanische Verfahrenstechnik I und II. Springer Verlag, Berlin, 1992.

Course: Particle Technology I (Laborpraktikum)

Lecturer:

Prof. Stefan Heinrich

Language:

DE

Cycle:

SS

Content:

- Sieving
- Bulk properties
- Size reduction
- Mixing
- Gas cyclone
- Blaine-test, filtration
- Sedimentation

Literature:

Schubert, H.; Heidenreich, E.; Liepe, F.; Neeße, T.: Mechanische Verfahrenstechnik. Deutscher Verlag für die Grundstoffindustrie, Leipzig, 1990.
Stieß, M.: Mechanische Verfahrenstechnik I und II. Springer Verlag, Berlin, 1992.

Specialisation Electrical Engineering

Module: Electrical Engineering III: Circuit Theory and Transients

Courses:

Title	Typ	Hrs/wk
Circuit Theory	Vorlesung	3
Circuit Theory	Gruppenübung	2

Module Responsibility:
Prof. Arne Jacob

Admission Requirements:

Recommended Previous Knowledge:
Electrical Engineering I and II, Mathematics I and II

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students are able to explain the basic methods for calculating electrical circuits. They know the Fourier series analysis of linear networks driven by periodic signals. They know the methods for transient analysis of linear networks in time and in frequency domain, and they are able to explain the frequency behaviour and the synthesis of passive two-terminal-circuits.

Capabilities:
The students are able to calculate currents and voltages in linear networks by means of basic methods, also when driven by periodic signals. They are able to calculate transients in electrical circuits in time and frequency domain and are able to explain the respective transient behaviour. They are able to analyse and to synthesize the frequency behaviour of passive two-terminal-circuits.

Personal Competence:
Social Competence:
Students work on exercise tasks in small guided groups. They are encouraged to present and discuss their results within the group.

Autonomy:
The students are able to find out the required methods for solving the given practice problems. Possibilities are given to test their knowledge during the lectures continuously by means of short-time tests. This allows them to control independently their educational objectives. They can link their gained knowledge to other courses like Electrical Engineering I and Mathematics I.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 110, Study Time in Lecture: 70

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Electrical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Mechatronics: Compulsory
Electrical Engineering: Kernqualifikation: Compulsory
Electrical Engineering myTrack: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Electrical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Mechatronics: Compulsory
Mechatronics: Kernqualifikation: Compulsory
Technomathematics: Vertiefung Engineering Science: Compulsory suffrage

Course: Circuit Theory (Vorlesung)

Lecturer:
Prof. Arne Jacob

Language:
DE

Cycle:
WS

Content:

- Circuit theorems
- N-port circuits
- Periodic excitation of linear circuits
- Transient analysis in time domain
- Transient analysis in frequency domain; Laplace Transform
- Frequency behaviour of passive one-ports

Literature:

- M. Albach, "Grundlagen der Elektrotechnik 1", Pearson Studium (2011)
- M. Albach, "Grundlagen der Elektrotechnik 2", Pearson Studium (2011)
- L. P. Schmidt, G. Schaller, S. Martius, "Grundlagen der Elektrotechnik 3", Pearson Studium (2011)
- T. Harriehausen, D. Schwarzenau, "Moeller Grundlagen der Elektrotechnik", Springer (2013)
- A. Hambley, "Electrical Engineering: Principles and Applications", Pearson (2008)
- R. C. Dorf, J. A. Svoboda, "Introduction to electrical circuits", Wiley (2006)
- L. Moura, I. Darwazeh, "Introduction to Linear Circuit Analysis and Modeling", Amsterdam Newnes (2005)

Course: Circuit Theory (Übung)

Lecturer:
Prof. Arne Jacob

Language:
DE

Cycle:
WS

Content:

Literature:

Module: Theoretical Electrical Engineering I: Time-Independent Fields

Courses:

Title	Typ	Hrs/wk
Theoretical Electrical Engineering I: Time-Independent Fields	Vorlesung	3
Theoretical Electrical Engineering I: Time-Independent Fields	Gruppenübung	2

Module Responsibility:
Prof. Christian Schuster

Admission Requirements:
Elektrotechnik I, Elektrotechnik II, Mathematik I, Mathematik II, Mathematik III

Recommended Previous Knowledge:
Basic principles of electrical engineering and advanced mathematics

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students can explain the fundamental formulas, relations, and methods of the theory of time-independent electromagnetic fields. They can explicate the principal behavior of electrostatic, magnetostatic, and current density fields with regard to respective sources. They can describe the properties of complex electromagnetic fields by means of superposition of solutions for simple fields. The students are aware of applications for the theory of time-independent electromagnetic fields and are able to explicate these.

Capabilities:
Students can apply Maxwell's Equations in integral notation in order to solve highly symmetrical, time-independent, electromagnetic field problems. Furthermore, they are capable of applying a variety of methods that require solving Maxwell's Equations for more general problems. The students can assess the principal effects of given time-independent sources of fields and analyze these quantitatively. They can deduce meaningful quantities for the characterization of electrostatic, magnetostatic, and electrical flow fields (capacitances, inductances, resistances, etc.) from given fields and dimension them for practical applications.

Personal Competence:
Social Competence:
Students are able to work together on subject related tasks in small groups. They are able to present their results effectively (e.g. during exercise sessions).

Autonomy:
Students are capable to gather necessary information from provided references and relate this information to the lecture. They are able to continually reflect their knowledge by means of activities that accompany the lecture, such as short oral quizzes during the lectures and exercises that are related to the exam. Based on respective feedback, students are expected to adjust their individual learning process. They are able to draw connections between their knowledge obtained in this lecture and the content of other lectures (e.g. Electrical Engineering I, Linear Algebra, and Analysis).

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 110, Study Time in Lecture: 70

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Electrical Engineering: Compulsory
Electrical Engineering: Kernqualifikation: Compulsory
Electrical Engineering myTrack: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Electrical Engineering: Compulsory
Computational Science and Engineering: Vertiefung Engineering Sciences: Compulsory suffrage
Technomathematics: Vertiefung Engineering Science: Compulsory suffrage

Course: Theoretical Electrical Engineering I: Time-Independent Fields (Vorlesung)

Lecturer:
Prof. Christian Schuster

Language:
DE

Cycle:

SS

Content:

- Maxwell’s Equations in integral and differential notation
- Boundary conditions
- Laws of conservation for energy and charge
- Classification of electromagnetic field properties
- Integral characteristics of time-independent fields (R, L, C)
- Generic approaches to solving Poisson’s Equation
- Electrostatic fields and specific methods of solving
- Magnetostatic fields and specific methods of solving
- Fields of electrical current density and specific methods of solving
- Action of force within time-independent fields
- Numerical methods for solving time-independent problems

Literature:

- G. Lehner, "Elektromagnetische Feldtheorie: Für Ingenieure und Physiker", Springer (2010)
- H. Henke, "Elektromagnetische Felder: Theorie und Anwendung", Springer (2011)
- W. Nolting, "Grundkurs Theoretische Physik 3: Elektrodynamik", Springer (2011)
- D. Griffiths, "Introduction to Electrodynamics", Pearson (2012)
- J. Edminister, " Schaum's Outline of Electromagnetics", Mcgraw-Hill (2013)
- Richard Feynman, "Feynman Lectures on Physics: Volume 2", Basic Books (2011)

Course: Theoretical Electrical Engineering I: Time-Independent Fields (Übung)

Lecturer:

Prof. Christian Schuster

Language:

DE

Cycle:

SS

Content:

- Maxwell’s Equations in integral and differential notation
- Boundary conditions
- Laws of conservation for energy and charge
- Classification of electromagnetic field properties
- Integral characteristics of time-independent fields (R, L, C)
- Generic approaches to solving Poisson’s Equation
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- Richard Feynman, "Feynman Lectures on Physics: Volume 2", Basic Books (2011)

Module: Signals and Systems

Courses:

Title	Typ	Hrs/wk
Signals and Systems	Vorlesung	3
Signals and Systems	Hörsaalübung	1

Module Responsibility:
Prof. Gerhard Bauch

Admission Requirements:
Mathematics 1-3

Recommended Previous Knowledge:

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students are able to classify and describe signals and linear time-invariant (LTI) systems using methods of signal and system theory. They are able to apply the fundamental transformations of continuous-time and discrete-time signals and systems. They can describe and analyse deterministic signals and systems mathematically in both time and image domain. In particular, they understand the effects in time domain and image domain which are caused by the transition of a continuous-time signal to a discrete-time signal.
Capabilities:
The students are able to describe and analyse deterministic signals and linear time-invariant systems using methods of signal and system theory. They can analyse and design basic systems regarding important properties such as magnitude and phase response, stability, linearity etc.. They can assess the impact of LTI systems on the signal properties in time and frequency domain.

Personal Competence:
Social Competence:
The students can jointly solve specific problems.
Autonomy:
The students are able to acquire relevant information from appropriate literature sources. They can control their level of knowledge during the lecture period by solving tutorial problems, software tools, clicker system.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Electrical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Computer Science and Engineering: Compulsory
General Engineering Science (German program): Vertiefung Chemical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (German program): Vertiefung Civil- and Enviromental Engeneering: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Biomedical Engineering: Compulsory
Computer Science: Kernqualifikation: Compulsory
Electrical Engineering: Kernqualifikation: Compulsory
Electrical Engineering myTrack: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Civil- and Enviromental Engeneering: Compulsory
General Engineering Science (English program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (English program): Vertiefung Electrical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Computer Science and Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Chemical Engineering: Compulsory
Computational Science and Engineering: Kernqualifikation: Compulsory
Mechatronics: Kernqualifikation: Compulsory
Technomathematics: Vertiefung Engineering Science: Compulsory suffrage

Course: Signals and Systems (Vorlesung)

Lecturer:
Prof. Gerhard Bauch

Language:
DE/EN

Cycle:
SS

Content:

- Basic classification and description of continuous-time and discrete-time signals and systems
- Concvolution
- Power and energy of signals
- Correlation functions of deterministic signals
- Linear time-invariant (LTI) systems
- Signal transformations:
  - Fourier-Series
  - Fourier Transform
  - Laplace Transform
  - Discrete-time Fourier Transform
  - Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT)
  - Z-Transform
- Analysis and design of LTI systems in time and frequency domain
- Basic filter types
- Sampling, sampling theorem
- Fundamentals of recursive and non-recursive discrete-time filters

Literature:

- T. Frey , M. Bossert , Signal- und Systemtheorie, B.G. Teubner Verlag 2004
- K. Kammeyer, K. Kroschel, Digitale Signalverarbeitung, Teubner Verlag.
- B. Girod ,R. Rabensteiner , A. Stenger , Einführung in die Systemtheorie, B.G. Teubner, Stuttgart, 1997
- J.R. Ohm, H.D. Lüke , Signalübertragung, Springer-Verlag 8. Auflage, 2002
- S. Haykin, B. van Veen: Signals and systems. Wiley.
- Oppenheim, A.S. Willsky: Signals and Systems. Pearson.
- Oppenheim, R. W. Schafer: Discrete-time signal processing. Pearson.

Course: Signals and Systems (Übung)

Lecturer:
Prof. Gerhard Bauch

Language:
DE/EN

Cycle:
SS

Content:

- Basic classification and description of continuous-time and discrete-time signals and systems
- Concvolution
- Power and energy of signals
- Correlation functions of deterministic signals
- Linear time-invariant (LTI) systems
- Signal transformations:
  - Fourier-Series
  - Fourier Transform
  - Laplace Transform
  - Discrete-time Fourier Transform
  - Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT)
  - Z-Transform
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- Basic filter types
- Sampling, sampling theorem
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- K. Kammeyer, K. Kroschel, Digitale Signalverarbeitung, Teubner Verlag.
- B. Girod ,R. Rabensteiner , A. Stenger , Einführung in die Systemtheorie, B.G. Teubner, Stuttgart, 1997
- J.R. Ohm, H.D. Lüke , Signalübertragung, Springer-Verlag 8. Auflage, 2002
- S. Haykin, B. van Veen: Signals and systems. Wiley.
- Oppenheim, A.S. Willsky: Signals and Systems. Pearson.
- Oppenheim, R. W. Schafer: Discrete-time signal processing. Pearson.

Courses:

Title	Typ	Hrs/wk
Research Seminar Electrical Engineering, Computer Science, Mathematics	Seminar	2
Transmission Line Theory	Vorlesung	2
Transmission Line Theory	Hörsaalübung	2

Module Responsibility:
Prof. Arne Jacob

Admission Requirements:

Recommended Previous Knowledge:
Electrical Engineering I-III, Mathematics I-III

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students can explain the fundamentals of wave propagation on transmission lines at low and high frequencies. They are able to analyze circuits with transmission lines in time and frequency domain. They can describe simple equivalent circuits of transmission lines. They are able to solve problems with coupled transmission lines. They can present and discuss a self-chosen research topic.

Capabilities:
Students can analyze and calculate the propagation of waves in simple circuits with transmission lines. They are able to analyze circuits in frequency domain and with the Smith chart. They can analyze equivalent circuits of transmission lines. They are able to solve problems including coupled transmission lines using the vectorial transmission line equations. They are able to give a talk to professionals.

Personal Competence:
Social Competence:
Students can analyze and solve problems in small groups and discuss their solutions. They can compare the learned theory with experiments in the lecture and discuss it in small groups. They are able to present a research topic to professionals and discuss it with them.

Autonomy:
The students can solve problems by their own and are able to acquire skills from the lecture and the literature. They are able to test their knowledge using computer animations. They can test their level of knowledge by answering short questions and tests during the lecture. They are able to relate their acquired knowledge to other lectures (e.g. Electrical Engineering I-III and Mathematics I-III). They can familiarize themselves with a research topic and can prepare a presentation.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 96, Study Time in Lecture: 84

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Electrical Engineering: Compulsory
Electrical Engineering: Kernqualifikation: Compulsory
Electrical Engineering myTrack: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Electrical Engineering: Compulsory
Technomathematics: Kernqualifikation: Compulsory suffrage

Course: Research Seminar Electrical Engineering, Computer Science, Mathematics (Seminar)

Lecturer:
Dozenten des SD E

Language:
DE/EN

Cycle:
SS

Content:
Seminar talk on a given subject

Literature:

Course: Transmission Line Theory (Vorlesung)

Lecturer:
Prof. Arne Jacob

Language:
DE

Cycle:
SS

Content:
- Wave propagation along transmission lines
- Transient behavior of transmission lines
- Transmission lines in steady state
- Impedance transformation and Smith chart
- Equivalent circuits
- Coupled transmission lines and symmetrical components

Literature:
- Unger, H.-G., "Elektromagnetische Wellen auf Leitungen", Hüthig Verlag (1991)

Course: Transmission Line Theory (Übung)

Lecturer:
Prof. Arne Jacob

Language:
DE

Cycle:
SS

Content:
- Wave propagation along transmission lines
- Transient behavior of transmission lines
- Transmission lines in steady state
- Impedance transformation and Smith chart
- Equivalent circuits
- Coupled transmission lines and symmetrical components

Literature:
- Unger, H.-G., "Elektromagnetische Wellen auf Leitungen", Hüthig Verlag (1991)

Module: Electrical Engineering Project Laboratory

Courses:

Title	Typ	Hrs/wk
Electrical Engineering Project Laboratory	Laborpraktikum	5

Module Responsibility:
Prof. Christian Schuster

Admission Requirements:
Elektrotechnik I, Elektrotechnik II

Recommended Previous Knowledge:
Basic principles of electrical engineering

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students are able to give a summary of the technical details of projects in the area of electrical engineering and illustrate respective relationships. They are capable of describing and communicating relevant problems and questions using appropriate technical language. They can explain the typical process of solving practical problems and present related results.

Capabilities:
The students can transfer their fundamental knowledge on electrical engineering to the process of solving practical problems. They identify and overcome typical problems during the realization of projects in the context of electrical engineering. Students are able to develop, compare, and choose conceptual solutions for non-standardized problems.

Personal Competence:
Social Competence:
Students are able to cooperate in small, mixed-subject groups in order to independently derive solutions to given problems in the context of electrical engineering. They are able to effectively present and explain their results alone or in groups in front of a qualified audience. Students have the ability to develop alternative approaches to an electrical engineering problem independently or in groups and discuss advantages as well as drawbacks.

Autonomy:
Students are capable of independently solving electrical engineering problems using provided literature. They are able to fill gaps in as well as extent their knowledge using the literature and other sources provided by the supervisor. Furthermore, they can meaningfully extend given problems and pragmatically solve them by means of corresponding solutions and concepts.

ECTS-Credit points:
6 LP

Examination:
Projektarbeit

Workload in Hours:
Indipendent Study Time: 110, Study Time in Lecture: 70

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Electrical Engineering: Compulsory
Electrical Engineering: Kernqualifikation: Compulsory
Electrical Engineering myTrack: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Electrical Engineering: Compulsory
Technomathematics: Kernqualifikation: Compulsory suffrage

Course: Electrical Engineering Project Laboratory (Laborpraktikum)

Lecturer:
Prof. Christian Schuster, Dozenten des SD E

Language:
DE

Cycle:
SS

Content:
Topics and projects cover the entire field of applications of electrical engineering. Typically, the students will prototype functional units and self-contained systems, such as radar devices, networks of sensors, amateur radio transceiver, discrete computers, or atomic force microscopes. Different projects are devised on a yearly basis.

Literature:

Alle zur Durchführung der Projekte sinnvollen Quellen (Skripte, Fachbücher, Manuals, Datenblätter, Internetseiten). / All sources that are useful for completion of the projects (lecture notes, textbooks, manuals, data sheets, internet pages).

Module: Materials in Electrical Engineering

Courses:

Title	Typ	Hrs/wk
Electrotechnical Experiments	Vorlesung	1
Materials in Electrical Engineering	Vorlesung	2
Materials in Electrical Engineering (Problem Solving Course)	Gruppenübung	2

Module Responsibility:
Prof. Manfred Eich

Admission Requirements:
Highschool diploma

Recommended Previous Knowledge:
Highschool level physics and mathematics

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students can explain the composition and the structural properties of materials used in electrical engineering. Students can explicate the relevance of mechanical, electrical, thermal, dielectric, magnetic and chemical properties of materials in view of their applications in electrical engineering.
Capabilities:
Students can identify appropriate descriptive models and apply them mathematically. They can derive approximative solutions and judge factors influential on the performance of materials in electrical engineering applications.

Personal Competence:
Social Competence:
Students can jointly solve subject related problems in groups. They can present their results effectively within the framework of the problem solving course.

Autonomy:
Students are capable to extract relevant information from the provided references and to relate this information to the content of the lecture. They can reflect their acquired level of expertise with the help of lecture accompanying measures such as exam typical exam questions. Students are able to connect their knowledge with that acquired from other lectures.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 110, Study Time in Lecture: 70

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Electrical Engineering: Compulsory
Electrical Engineering: Kernqualifikation: Compulsory
Electrical Engineering myTrack: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Electrical Engineering: Compulsory

Course: Electrotechnical Experiments (Vorlesung)

Lecturer:
Dr. Wieland Hingst

Language:
DE

Cycle:
SS

Content:
Agenda:
- Natural sources of electricity
- Oscilloscope
- Characterizing signals
- 2 terminal circuit elements
- 2-ports
- Power

- Matching
- Inductive coupling
- Resonance
- Radio frequencies
- Transistor circuits
- Electrical measurement
- Materials for the EE
- Electrical fun

Literature:
Tietze, Schenk: "Halbleiterschaltungstechnik", Springer

Course: Materials in Electrical Engineering (Vorlesung)

Lecturer:
Prof. Manfred Eich

Language:
DE

Cycle:
SS

Content:

- Atom structure and periodic system
- Atom binding and crystal structure
- Structure and properties of alloys:
  diffusion, phase diagrams, phase separation and grain boundaries
- Material properties:
  Mechanical, thermal, electrical, dielectric properties
- Metals
- Semiconductors
- Ceramics and glasses
- Polymers
- Magnetic materials
- Electrochemistry
  Oxidation numbers, electrolysis, batteries, fuel cells

Literature:
H. Schaumburg: Einführung in die Werkstoffe der Elektrotechnik, Teubner (1993)

Course: Materials in Electrical Engineering (Problem Solving Course) (Übung)

Lecturer:
Prof. Manfred Eich

Language:
DE

Cycle:
SS

Content:

- Atom structure and periodic system
- Atom binding and crystal structure
- Structure and properties of alloys:
  diffusion, phase diagrams, phase separation and grain boundaries
- Material properties:
  Mechanical, thermal, electrical, dielectric properties
- Metals
- Semiconductors
- Ceramics and glasses
- Polymers
- Magnetic materials
- Electrochemistry
  Oxidation numbers, electrolysis, batteries, fuel cells

Literature:
H. Schaumburg: Einführung in die Werkstoffe der Elektrotechnik, Teubner (1993)

Courses:

Title	Typ	Hrs/wk
Differential Equations 2 (Partial Differential Equations)	Vorlesung	2
Differential Equations 2 (Partial Differential Equations)	Gruppenübung	1
Differential Equations 2 (Partial Differential Equations)	Hörsaalübung	1
Complex Functions	Vorlesung	2
Complex Functions	Gruppenübung	1
Complex Functions	Hörsaalübung	1

Module Responsibility:
Prof. Anusch Taraz

Admission Requirements:
none

Recommended Previous Knowledge:
Mathematics 1 - III

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:

- Students can name the basic concepts in Mathematics IV. They are able to explain them using appropriate examples.
- Students can discuss logical connections between these concepts. They are capable of illustrating these connections with the help of examples.
- They know proof strategies and can reproduce them.

Capabilities:

- Students can model problems in Mathematics IV with the help of the concepts studied in this course. Moreover, they are capable of solving them by applying established methods.
- Students are able to discover and verify further logical connections between the concepts studied in the course.
- For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results.

Personal Competence:
Social Competence:

- Students are able to work together in teams. They are capable to use mathematics as a common language.
- In doing so, they can communicate new concepts according to the needs of their cooperating partners. Moreover, they can design examples to check and deepen the understanding of their peers.

Autonomy:

- Students are capable of checking their understanding of complex concepts on their own. They can specify open questions precisely and know where to get help in solving them.
- Students have developed sufficient persistence to be able to work for longer periods in a goal-oriented manner on hard problems.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 68, Study Time in Lecture: 112

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Electrical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Mechatronics: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Theoretical Mechanical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Naval Architecture: Compulsory
Computer Science: Vertiefung Computational Mathematics: Compulsory suffrage
Electrical Engineering: Kernqualifikation: Compulsory

Electrical Engineering myTrack: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Electrical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Naval Architecture: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Mechatronics: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Theoretical Mechanical Engineering: Compulsory
Computational Science and Engineering: Vertiefung Engineering Sciences: Compulsory suffrage
Mechanical Engineering: Vertiefung Theoretical Mechanical Engineering: Compulsory
Mechanical Engineering: Vertiefung Mechatronics: Compulsory
Mechatronics: Kernqualifikation: Compulsory
Naval Architecture: Kernqualifikation: Compulsory

Course: Differential Equations 2 (Partial Differential Equations) (Vorlesung)

Lecturer:
Dozenten des Fachbereiches Mathematik der UHH

Language:
DE

Cycle:
SS

Content:
Main features of the theory and numerical treatment of partial differential equations

- Examples of partial differential equations
- First order quasilinear differential equations
- Normal forms of second order differential equations
- Harmonic functions and maximum principle
- Maximum principle for the heat equation
- Wave equation
- Liouville's formula
- Special functions
- Difference methods
- Finite elements

Literature:

- R. Ansorge, H. J. Oberle: Mathematik für Ingenieure, Band 2; Verlag Wiley-VCH, Berlin, Weinheim, New York, 2000
- P. Henrici, R. Jelsch: Komplexe Analysis für Ingenieure, Birkhäuser Verlag, Basel, 1998
- A. Tveito, R. Winther: Einführung in partielle Differentialgleichungen, Springer Verlag, Berlin, Heidelberg, New York, 2002

Course: Differential Equations 2 (Partial Differential Equations) (Übung)

Lecturer:
Dozenten des Fachbereiches Mathematik der UHH

Language:
DE

Cycle:
SS

Content:
Main features of the theory and numerical treatment of partial differential equations

- Examples of partial differential equations
- First order quasilinear differential equations
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- P. Henrici, R. Jelsch: Komplexe Analysis für Ingenieure, Birkhäuser Verlag, Basel, 1998
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Course: Differential Equations 2 (Partial Differential Equations) (Ubung)

Lecturer:
Dozenten des Fachbereiches Mathematik der UHH

Language:
DE

Cycle:
SS

Content:
Main features of the theory and numerical treatment of partial differential equations

- Examples of partial differential equations
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- A. Tveito, R. Winther: Einführung in partielle Differentialgleichungen, Springer Verlag, Berlin, Heidelberg, New York, 2002

Course: Complex Functions (Vorlesung)

Lecturer:
Dozenten des Fachbereiches Mathematik der UHH

Language:
DE

Cycle:
SS

Content:
Main features of complex analysis

- Functions of one complex variable
- Complex differentiation
- Conformal mappings
- Complex integration
- Cauchy's integral theorem
- Cauchy's integral formula
- Taylor and Laurent series expansion
- Singularities and residuals
- Integral transformations: Fourier and Laplace transformation

Literature:

- R. Ansorge, H. J. Oberle: Mathematik für Ingenieure, Band 2; Verlag Wiley-VCH, Berlin, Weinheim, New York, 2000
- P. Henrici, R. Jelsch: Komplexe Analysis für Ingenieure, Birkhäuser Verlag, Basel, 1998

Course: Complex Functions (Übung)

Lecturer:
Dozenten des Fachbereiches Mathematik der UHH

Language:
DE

Cycle:
SS

Content:
Main features of complex analysis

- Functions of one complex variable
- Complex differentiation
- Conformal mappings

- Complex integration
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Literature:

- R. Ansorge, H. J. Oberle: Mathematik für Ingenieure, Band 2; Verlag Wiley-VCH, Berlin, Weinheim, New York, 2000
- P. Henrici, R. Jelsch: Komplexe Analysis für Ingenieure, Birkhäuser Verlag, Basel, 1998

Course: Complex Functions (Übung)

Lecturer:
Dozenten des Fachbereiches Mathematik der UHH

Language:
DE

Cycle:
SS

Content:
Main features of complex analysis

- Functions of one complex variable
- Complex differentiation
- Conformal mappings
- Complex integration
- Cauchy's integral theorem
- Cauchy's integral formula
- Taylor and Laurent series expansion
- Singularities and residuals
- Integral transformations: Fourier and Laplace transformation

Literature:

- R. Ansorge, H. J. Oberle: Mathematik für Ingenieure, Band 2; Verlag Wiley-VCH, Berlin, Weinheim, New York, 2000
- P. Henrici, R. Jelsch: Komplexe Analysis für Ingenieure, Birkhäuser Verlag, Basel, 1998

Module: Theoretical Electrical Engineering II: Time-Dependent Fields

Courses:

Title	Typ	Hrs/wk
Theoretical Electrical Engineering II: Time-Dependent Fields	Vorlesung	3
Theoretical Electrical Engineering II: Time-Dependent Fields	Gruppenübung	2

Module Responsibility:
Prof. Christian Schuster

Admission Requirements:
Elektrotechnik I, Elektrotechnik II, Mathematik I, Mathematik II, Mathematik III, Mathematik IV, Theoretische Elektrotechnik I

Recommended Previous Knowledge:
Basic principles of electrical engineering and advanced mathematics

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students are able to explain fundamental formulas, relations, and methods related to the theory of time-dependent electromagnetic fields. They can assess the principal behavior and characteristics of quasistationary and fully dynamic fields with regard to respective sources. They can describe the properties of complex electromagnetic fields by means of superposition of solutions for simple fields. The students are aware of applications for the theory of time-dependent electromagnetic fields and are able to explicate these.

Capabilities:
Students are able to apply a variety of procedures in order to solve the diffusion and the wave equation for general time-dependent field problems. They can assess the principal effects of given time-dependent sources of fields and analyze these quantitatively. They can deduce meaningful quantities for the characterization of fully dynamic fields (wave impedance, skin depth, Poynting-vector, radiation resistance, etc.) from given fields and interpret them with regard to practical applications.

Personal Competence:
Social Competence:
Students are able to work together on subject related tasks in small groups. They are able to present their results effectively (e.g. during exercise sessions).

Autonomy:
Students are capable to gather necessary information from provided references and relate this information to the lecture. They are able to continually reflect their knowledge by means of activities that accompany the lecture, such as short oral quizzes during the lectures and exercises that are related to the exam. Based on respective feedback, students are expected to adjust their individual learning process. They are able to draw connections between acquired knowledge and ongoing research at the Hamburg University of Technology (TUHH), e.g. in the area of high frequency engineering and optics.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 110, Study Time in Lecture: 70

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Electrical Engineering: Compulsory
Electrical Engineering: Kernqualifikation: Compulsory
Electrical Engineering myTrack: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Electrical Engineering: Compulsory
Computational Science and Engineering: Vertiefung Engineering Sciences: Compulsory suffrage
Technomathematics: Kernqualifikation: Compulsory suffrage

Course: Theoretical Electrical Engineering II: Time-Dependent Fields (Vorlesung)

Lecturer:
Prof. Christian Schuster

Language:
DE

Cycle:
WS

Content:

- Theory and principal characteristics of quasistationary electromagnetic fields
- Electromagnetic induction and law of induction
- Skin effect and eddy currents
- Shielding of time variable magnetic fields
- Theory and principal characteristics of fully dynamic electromagnetic fields
- Wave equations and properties of planar waves
- Polarization and superposition of planar waves
- Reflection and refraction of planar waves at boundary surfaces
- Waveguide theory
- Rectangular waveguide, planar optical waveguide
- Elektrical and magnetical dipol radiation
- Simple arrays of antennas

Literature:

- G. Lehner, "Elektromagnetische Feldtheorie: Für Ingenieure und Physiker", Springer (2010)
- H. Henke, "Elektromagnetische Felder: Theorie und Anwendung", Springer (2011)
- W. Nolting, "Grundkurs Theoretische Physik 3: Elektrodynamik", Springer (2011)
- D. Griffiths, "Introduction to Electrodynamics", Pearson (2012)
- J. Edminister, "Schaum's Outline of Electromagnetics", Mcgraw-Hill (2013)
- Richard Feynman, "Feynman Lectures on Physics: Volume 2", Basic Books (2011)

Course: Theoretical Electrical Engineering II: Time-Dependent Fields (Übung)

Lecturer:

Prof. Christian Schuster

Language:

DE

Cycle:

WS

Content:

- Theory and principal characteristics of quasistationary electromagnetic fields
- Electromagnetic induction and law of induction
- Skin effect and eddy currents
- Shielding of time variable magnetic fields
- Theory and principal characteristics of fully dynamic electromagnetic fields
- Wave equations and properties of planar waves
- Polarization and superposition of planar waves
- Reflection and refraction of planar waves at boundary surfaces
- Waveguide theory
- Rectangular waveguide, planar optical waveguide
- Elektrical and magnetical dipol radiation
- Simple arrays of antennas

Literature:

- G. Lehner, "Elektromagnetische Feldtheorie: Für Ingenieure und Physiker", Springer (2010)
- H. Henke, "Elektromagnetische Felder: Theorie und Anwendung", Springer (2011)
- W. Nolting, "Grundkurs Theoretische Physik 3: Elektrodynamik", Springer (2011)
- D. Griffiths, "Introduction to Electrodynamics", Pearson (2012)
- J. Edminister, "Schaum's Outline of Electromagnetics", Mcgraw-Hill (2013)
- Richard Feynman, "Feynman Lectures on Physics: Volume 2", Basic Books (2011)

Module: Introduction to Communications and Random Processes

Courses:

Title	Typ	Hrs/wk
Introduction to Communications and Random Processes	Vorlesung	3
Introduction to Communications and Random Processes	Hörsaalübung	1

Module Responsibility:
Prof. Gerhard Bauch

Admission Requirements:
Mathematics 1-3
Signals and Systems

Recommended Previous Knowledge:
Basic knowledge of probability theory

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students know and understand the fundamental building blocks of a communications system. They can describe and analyse the individual building blocks using knowledge of signal and system theory as well as the theory of stochastic processes. The are aware of the essential resources and evaluation criteria of information transmission and are able to design and evaluate a basic communications system.
Capabilities:
The students are able to design and evaluate a basic communications system. In particular, they can estimate the required resources in terms of bandwidth and power. They are able to assess essential evaluation parameters of a basic communications system such as bandwidth efficiency or bit error rate and to decide for a suitable transmission method.

Personal Competence:
Social Competence:
The students can jointly solve specific problems.
Autonomy:
The students are able to acquire relevant information from appropriate literature sources. They can control their level of knowledge during the lecture period by solving tutorial problems, software tools, clicker system.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Electrical Engineering: Compulsory
Computer Science: Vertiefung Computer Engineering: Compulsory suffrage
Electrical Engineering: Kernqualifikation: Compulsory
Electrical Engineering myTrack: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Electrical Engineering: Compulsory
Computational Science and Engineering: Vertiefung Computer Science: Compulsory suffrage
Technomathematics: Kernqualifikation: Compulsory suffrage

Course: Introduction to Communications and Random Processes (Vorlesung)

Lecturer:
Prof. Gerhard Bauch

Language:
DE/EN

Cycle:
WS

Content:

- Fundamentals of random processes
- Introduction to communications engineering
- Quadrature amplitude modulation
- Description of radio frequency transmission in the equivalent complex baseband
- Transmission channels, channel models
- Analog digital conversion: Sampling, quantization, pulsecode modulation (PCM)
- Fundamentals of information theory, source coding, channel coding

- Digital baseband transmission: Pulse shaping, eye diagramm, 1. and 2. Nyquist condition, matched filter, detection, error probability
- Fundamentals of digital modulation

Literature:

K. Kammeyer: Nachrichtenübertragung, Teubner
P.A. Höher: Grundlagen der digitalen Informationsübertragung, Teubner.
M. Bossert: Einführung in die Nachrichtentechnik, Oldenbourg.
J.G. Proakis, M. Salehi: Grundlagen der Kommunikationstechnik. Pearson Studium.
J.G. Proakis, M. Salehi: Digital Communications. McGraw-Hill.
S. Haykin: Communication Systems. Wiley
J.G. Proakis, M. Salehi: Communication Systems Engineering. Prentice-Hall.
J.G. Proakis, M. Salehi, G. Bauch, Contemporary Communication Systems. Cengage Learning.

Course: Introduction to Communications and Random Processes (Übung)

Lecturer:

Prof. Gerhard Bauch

Language:

DE/EN

Cycle:

WS

Content:

- Fundamentals of random processes
- Introduction to communications engineering
- Quadrature amplitude modulation
- Description of radio frequency transmission in the equivalent complex baseband
- Transmission channels, channel models
- Analog digital conversion: Sampling, quantization, pulsecode modulation (PCM)
- Fundamentals of information theory, source coding, channel coding
- Digital baseband transmission: Pulse shaping, eye diagramm, 1. and 2. Nyquist condition, matched filter, detection, error probability
- Fundamentals of digital modulation

Literature:

K. Kammeyer: Nachrichtenübertragung, Teubner
P.A. Höher: Grundlagen der digitalen Informationsübertragung, Teubner.
M. Bossert: Einführung in die Nachrichtentechnik, Oldenbourg.
J.G. Proakis, M. Salehi: Grundlagen der Kommunikationstechnik. Pearson Studium.
J.G. Proakis, M. Salehi: Digital Communications. McGraw-Hill.
S. Haykin: Communication Systems. Wiley
J.G. Proakis, M. Salehi: Communication Systems Engineering. Prentice-Hall.
J.G. Proakis, M. Salehi, G. Bauch, Contemporary Communication Systems. Cengage Learning.

Module: Electronic Devices

Courses:

Title	Typ	Hrs/wk
Electronic Devices	Vorlesung	3
Electronic Devices	Problemorientierte Lehrveranstaltung	2

Module Responsibility:
Prof. Hoc Khiem Trieu

Admission Requirements:
Successful participation of Physics for Engineers and Materials in Electrical Engineering or courses with equivalent contents

Recommended Previous Knowledge:
Atomic model and quantum theory, electrical currents in solid state materials, basics in solid-state physics

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:

Students are able

- to represent the basics of semiconductor physics,
- to explain the operating principle of important semiconductor devices,
- to outline device characteristics and equivalent circuits as well as to explain their derivation and
- to discuss the limitation of device models.

Capabilities:

Students are capable

- to apply devices in basic circuits,
- to realize the physical context and to solve complex problems by oneself

Personal Competence:
Social Competence:
Students are able to prepare and perform their lab experiments in team work as well as to present and discuss the results in front of audience.
Autonomy:
Students are capable to acquire knowledge based on literature in order to prepare their experiments.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 110, Study Time in Lecture: 70

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Electrical Engineering: Compulsory
Electrical Engineering: Kernqualifikation: Compulsory
Electrical Engineering myTrack: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Electrical Engineering: Compulsory
Computational Science and Engineering: Vertiefung Computer Science: Compulsory suffrage

Course: Electronic Devices (Vorlesung)

Lecturer:
Prof. Hoc Khiem Trieu

Language:
DE

Cycle:
WS

Content:

- Uniformly doped semiconductor (semiconductor, crystal structure, energy band diagram, effective mass, density of state, probability of

occupancy, mass action law, generation and recombination processes, generation and recombination lifetime, carrier transport mechanisms: drift current, diffusion current; equilibriums in semiconductor, semiconductor equations)

- pn-junction (zero applied bias, energy band diagram in thermal equilibrium, current-voltage characteristics, derivation of diode equation, consideration of space charge recombination, transient behaviour, breakdown mechanisms, various types of diodes: Zener diode, tunnel diode, backward diode, photo diode, LED, laser diode)
- Bipolar transistor (principle of operation, current-voltage characteristics: calculation of base, collector and emitter current, operating modes; non-ideality: actual doping profile, Early effect, breakdown, generation and recombination current and high injection; Ebers-Moll model: family of characteristics, equivalent circuit; frequency response, switching characteristics, heterojunction bipolar transistor)
- Unipolar devices (surface effects: surface states, work function, energy band diagram; metal-semiconductor junctions: Schottky contact, current-voltage characteristics, ohmic contact; junction field effect transistor: operating principle, current-voltage characteristics, small-signal model, breakdown characteristics; MESFET: operating principle, depletion mode and enhancement mode MESFET; MIS structure: accumulation, depletion, inversion, strong inversion, flatband voltage, oxide charges, threshold voltage, capacitance voltage characteristics; MOSFET: basic structure, principle of operation, current voltage characteristics, frequency response, subthreshold behaviour, threshold voltage, device scaling; CMOS)

Literature:

S.M. Sze: Semiconductor devices, Physics and Technology, John Wiley & Sons (1985)F. Thuselt: Physik der Halbleiterbauelemente, Springer (2011)
T. Thille, D. Schmitt-Landsiedel: Mikroelektronik, Halbleiterbauelemente und deren Anwendung in elektronischen Schaltungen, Springer (2004)
B.L. Anderson, R.L. Anderson: Fundamentals of Semiconductor Devices, McGraw-Hill (2005)
D.A. Neamen: Semiconductor Physics and Devices, McGraw-Hill (2011)
M. Shur: Introduction to Electronic Devices, John Wiley & Sons (1996)
S.M. Sze: Physics of semiconductor devices, John Wiley & Sons (2007)
H. Schaumburg: Halbleiter, B.G. Teubner (1991)
A. Möschwitzer: Grundlagen der Halbleiter-&Mikroelektronik, Bd1 Elektronische Halbleiterbauelemente, Carl Hanser (1992)
H.-G. Unger, W. Schultz, G. Weinhausen: Elektronische Bauelemente und Netzwerke I, Physikalische Grundlagen der Halbleiterbauelemente, Vieweg (1985)

Course: Electronic Devices (Problemorientierte Lehrveranstaltung)

Lecturer:
Prof. Hoc Khiem Trieu

Language:
DE

Cycle:
WS

Content:

- Uniformly doped semiconductor (semiconductor, crystal structure, energy band diagram, effective mass, density of state, probability of occupancy, mass action law, generation and recombination processes, generation and recombination lifetime, carrier transport mechanisms: drift current, diffusion current; equilibriums in semiconductor, semiconductor equations)
- pn-junction (zero applied bias, energy band diagram in thermal equilibrium, current-voltage characteristics, derivation of diode equation, consideration of space charge recombination, transient behaviour, breakdown mechanisms, various types of diodes: Zener diode, tunnel diode, backward diode, photo diode, LED, laser diode)
- Bipolar transistor (principle of operation, current-voltage characteristics: calculation of base, collector and emitter current, operating modes; non-ideality: actual doping profile, Early effect, breakdown, generation and recombination current and high injection; Ebers-Moll model: family of characteristics, equivalent circuit; frequency response, switching characteristics, heterojunction bipolar transistor)
- Unipolar devices (surface effects: surface states, work function, energy band diagram; metal-semiconductor junctions: Schottky contact, current-voltage characteristics, ohmic contact; junction field effect transistor: operating principle, current-voltage characteristics, small-signal model, breakdown characteristics; MESFET: operating principle, depletion mode and enhancement mode MESFET; MIS structure: accumulation, depletion, inversion, strong inversion, flatband voltage, oxide charges, threshold voltage, capacitance voltage characteristics; MOSFET: basic structure, principle of operation, current voltage characteristics, frequency response, subthreshold behaviour, threshold voltage, device scaling; CMOS)

Literature:

S.M. Sze: Semiconductor devices, Physics and Technology, John Wiley & Sons (1985)F. Thuselt: Physik der Halbleiterbauelemente, Springer (2011)
T. Thille, D. Schmitt-Landsiedel: Mikroelektronik, Halbleiterbauelemente und deren Anwendung in elektronischen Schaltungen, Springer (2004)
B.L. Anderson, R.L. Anderson: Fundamentals of Semiconductor Devices, McGraw-Hill (2005)
D.A. Neamen: Semiconductor Physics and Devices, McGraw-Hill (2011)
M. Shur: Introduction to Electronic Devices, John Wiley & Sons (1996)
S.M. Sze: Physics of semiconductor devices, John Wiley & Sons (2007)
H. Schaumburg: Halbleiter, B.G. Teubner (1991)
A. Möschwitzer: Grundlagen der Halbleiter-&Mikroelektronik, Bd1 Elektronische Halbleiterbauelemente, Carl Hanser (1992)
H.-G. Unger, W. Schultz, G. Weinhausen: Elektronische Bauelemente und Netzwerke I, Physikalische Grundlagen der Halbleiterbauelemente, Vieweg (1985)

Module: Measurements: Methods and Data Processing

Courses:

Title	Typ	Hrs/wk
EE Experimental Lab	Laborpraktikum	2
Measurements: Methods and Data Processing	Vorlesung	2
Measurements: Methods and Data Processing	Gruppenübung	1

Module Responsibility:
Prof. Alexander Schlaefer

Admission Requirements:

Recommended Previous Knowledge:
principles of mathematics
principles of electrical engineering

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students are able to explain the purpose of metrology and the acquisition and processing of measurements. They can detail aspects of probability theory and errors, and explain the processing of stochastic signals. Students know methods to digitalize and describe measured signals.

Capabilities:
The students are able to evaluate problems of metrology and to apply methods for describing and processing of measurements.

Personal Competence:
Social Competence:

Autonomy:
The students can reflect their knowledge and discuss and evaluate their results.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 110, Study Time in Lecture: 70

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Electrical Engineering: Compulsory
Electrical Engineering: Kernqualifikation: Compulsory
Electrical Engineering myTrack: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Electrical Engineering: Compulsory
Technomathematics: Kernqualifikation: Compulsory suffrage

Course: EE Experimental Lab (Laborpraktikum)

Lecturer:
Prof. Alexander Schlaefer, Prof. Christian Schuster, Prof. Günter Ackermann, Prof. Rolf-Rainer Grigat, Prof. Arne Jacob, Prof. Georg Friedrich Mayer-Lindenberg, Prof. Herbert Werner, Dozenten des SD E

Language:
DE

Cycle:
WS

Content:
lab experiments: digital circuits, semiconductors, micro controllers, analog circuits, AC power, electrical machines

Literature:
Wird in der Lehrveranstaltung festgelegt

Course: Measurements: Methods and Data Processing (Vorlesung)

Lecturer:

Prof. Alexander Schlaefer

Language:
DE

Cycle:
WS

Content:
introduction, systems and errors in metrology, probability theory, measuring stochastic signals, describing measurements, acquisition of analog signals, applied metrology

Literature:
Puente León, Kiencke: Messtechnik, Springer 2012
Lerch: Elektrische Messtechnik, Springer 2012
Reisig: Petrinetze: Modellierungstechnik, Analysemethoden, Fallstudien; Vieweg+Teubner 2010

Weitere Literatur wird in der Veranstaltung bekanntgegeben.

Course: Measurements: Methods and Data Processing (Übung)

Lecturer:
Prof. Alexander Schlaefer

Language:
DE

Cycle:
WS

Content:
introduction, systems and errors in metrology, probability theory, measuring stochastic signals, describing measurements, acquisition of analog signals, applied metrology

Literature:
Puente León, Kiencke: Messtechnik, Springer 2012
Lerch: Elektrische Messtechnik, Springer 2012
Reisig: Petrinetze: Modellierungstechnik, Analysemethoden, Fallstudien; Vieweg+Teubner 2010

Weitere Literatur wird in der Veranstaltung bekanntgegeben.

Module: Semiconductor Circuit Design

Courses:

Title	Typ	Hrs/wk
Semiconductor Circuit Design	Vorlesung	3
Semiconductor Circuit Design	Gruppenübung	1

Module Responsibility:
Prof. Wolfgang Krautschneider

Admission Requirements:
none

Recommended Previous Knowledge:
Fundamentals of electrical engineering
Basics of physics

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:

- Students are able to explain the functionality of different MOS devices in electronic circuits.
- Students know the fundamental digital logic circuits and can discuss their advantages and disadvantages.
- Students have solid knowledge about memory circuits and can explain their functionality and specifications.
- Students are able to explain how analog circuits functions and where they are applied.
- Students know the appropriate fields for the use of bipolar transistors.

Capabilities:

- Students can calculate the specifications of different MOS devices and can define the parameters of electronic circuits.
- Students are able to develop different logic circuits and can design different types of logic circuits.
- Students can use MOS devices, operational amplifiers and bipolar transistors for specific applications.

Personal Competence:
Social Competence:

- Students are able work efficiently in heterogeneous teams.
- Students working together in small groups can solve problems and answer professional questions.

Autonomy:

- Students are able to assess their level of knowledge.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Electrical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Mechatronics: Compulsory
Computer Science: Vertiefung Computer Engineering: Compulsory suffrage
Electrical Engineering: Kernqualifikation: Compulsory
Electrical Engineering myTrack: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Electrical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Mechatronics: Compulsory
Computational Science and Engineering: Vertiefung Computer Science: Compulsory suffrage
Mechanical Engineering: Vertiefung Mechatronics: Compulsory
Mechatronics: Kernqualifikation: Compulsory
Technomathematics: Kernqualifikation: Compulsory suffrage

Course: Semiconductor Circuit Design (Vorlesung)

Lecturer:

Prof. Wolfgang Krautschneider

Language:
DE

Cycle:
SS

Content:

- Basic circuits with MOS transistors for logic gates and amplifiers
- Typical applications for analog and digital circuits
- Realization of logical functions
- Memory circuits
- Scaling-down of CMOS circuits and further perfomance improvements
- Operational amplifiers and their applications
- Basic circuits with bipolar transistors
- Design of exemplary circuits
- Electrical behavoir of BiCMOS circuits

Literature:
R. J. Baker, CMOS - Circuit Design, Layout and Simulation, J. Wiley & Sons Inc., 3. Auflage, 2011, ISBN: 047170055S
H.-G. Wagemann und T. Schönauer, Silizium-Planartechnologie, Grundprozesse, Physik und Bauelemente, Teubner-Verlag, 2003, ISBN 3519004674
K. Hoffmann, Systemintegration, Oldenbourg-Verlag, 2. Aufl. 2006, ISBN: 3486578944
U. Tietze und Ch. Schenk, E. Gamm, Halbleiterschaltungstechnik, Springer Verlag, 14. Auflage, 2012, ISBN 3540428496
H. Göbel, Einführung in die Halbleiter-Schaltungstechnik, Berlin, Heidelberg Springer-Verlag Berlin Heidelberg, 2011, ISBN: 9783642208874 ISBN: 9783642208867
URL: http://site.ebrary.com/lib/alltitles/docDetail.action?docID=10499499
URL: http://dx.doi.org/10.1007/978-3-642-20887-4
URL: http://ebooks.ciando.com/book/index.cfm/bok_id/319955
URL: http://www.ciando.com/img/bo

Course: Semiconductor Circuit Design (Übung)

Lecturer:
Prof. Wolfgang Krautschneider

Language:
DE

Cycle:
SS

Content:

- Basic circuits with MOS transistors for logic gates and amplifiers
- Typical applications for analog and digital circuits
- Realization of logical functions
- Memory circuits
- Scaling-down of CMOS circuits and further perfomance improvements
- Operational amplifiers and their applications
- Basic circuits with bipolar transistors
- Design of exemplary circuits
- Electrical behavoir of BiCMOS circuits

Literature:
R. J. Baker, CMOS - Circuit Design, Layout and Simulation, J. Wiley & Sons Inc., 3. Auflage, 2011, ISBN: 047170055S
H.-G. Wagemann und T. Schönauer, Silizium-Planartechnologie, Grundprozesse, Physik und Bauelemente, Teubner-Verlag, 2003, ISBN 3519004674
K. Hoffmann, Systemintegration, Oldenbourg-Verlag, 2. Aufl. 2006, ISBN: 3486578944
U. Tietze und Ch. Schenk, E. Gamm, Halbleiterschaltungstechnik, Springer Verlag, 14. Auflage, 2012, ISBN 3540428496
H. Göbel, Einführung in die Halbleiter-Schaltungstechnik, Berlin, Heidelberg Springer-Verlag Berlin Heidelberg, 2011, ISBN: 9783642208874 ISBN: 9783642208867
URL: http://site.ebrary.com/lib/alltitles/docDetail.action?docID=10499499
URL: http://dx.doi.org/10.1007/978-3-642-20887-4
URL: http://ebooks.ciando.com/book/index.cfm/bok_id/319955
URL: http://www.ciando.com/img/bo

Courses:

Title	Typ	Hrs/wk
Introduction to Management	Vorlesung	4
Project Entrepreneurship	Problemorientierte Lehrveranstaltung	2

Module Responsibility:
Prof. Kathrin Fischer

Admission Requirements:
None

Recommended Previous Knowledge:
Basic Knowledge of Mathematics and Business

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
After taking this module, students know the important basics of many different areas in Business and Management, from Planning and Organisation to Marketing and Innovation, and also to Investment and Controlling. In particular they are able to

- explain the differences between Economics and Management and the sub-disciplines in Management and to name important definitions from the field of Management
- explain the most important aspects of and goals in Management and name the most important aspects of entreprneurial projects
- describe and explain basic business functions as production, procurement and sourcing, supply chain management, organization and human ressource management, information management, innovation management and marketing
- explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives and uncertainty, and explain some basic methods from mathematical Finance
- state basics from accounting and costing and selected controlling methods.

Capabilities:
Students are able to analyse business units with respect to different criteria (organization, objectives, strategies etc.) and to carry out an Entrepreneurship project in a team. In particular, they are able to

- analyse Management goals and structure them appropriately
- analyse organisational and staff structures of companies
- apply methods for decision making under multiple objectives, under uncertainty and under risk
- analyse production and procurement systems and Business information systems
- analyse and apply basic methods of marketing
- select and apply basic methods from mathematical finance to predefined problems
- apply basic methods from accounting, costing and controlling to predefined problems

Personal Competence:
Social Competence:
Students are able to

- work successfully in a team of students
- to apply their knowledge from the lecture to an entrepreneurship project and write a coherent report on the project
- to communicate appropriately and
- to cooperate respectfully with their fellow students.

Autonomy:
Students are able to

- work in a team and to organize the team themselves
- to write a report on their project.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 96, Study Time in Lecture: 84

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Electrical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Computer Science and Engineering: Compulsory
General Engineering Science (German program): Vertiefung Chemical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Bioprocess Engineering: Compulsory

General Engineering Science (German program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (German program): Vertiefung Civil- and Enviromental Engeneering: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Naval Architecture: Compulsory
Civil- and Environmental Engeneering: Kernqualifikation: Compulsory
Bioprocess Engineering: Kernqualifikation: Compulsory
Computer Science: Kernqualifikation: Compulsory
Electrical Engineering: Kernqualifikation: Compulsory
Electrical Engineering myTrack: Kernqualifikation: Compulsory
Energy and Environmental Engineering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Civil- and Enviromental Engeneering: Compulsory
General Engineering Science (English program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (English program): Vertiefung Electrical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (English program): Vertiefung Computer Science and Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Naval Architecture: Compulsory
General Engineering Science (English program): Vertiefung Chemical Engineering: Compulsory
Computational Science and Engineering: Kernqualifikation: Compulsory
Logistics and Mobility: Kernqualifikation: Compulsory
Mechanical Engineering: Kernqualifikation: Compulsory
Mechatronics: Kernqualifikation: Compulsory
Naval Architecture: Kernqualifikation: Compulsory
Technomathematics: Kernqualifikation: Compulsory
Process Engineering: Kernqualifikation: Compulsory

Course: Introduction to Management (Vorlesung)

Lecturer:
Prof. Kathrin Fischer, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Cornelius Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona

Language:
DE

Cycle:
WS/SS

Content:

- Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management
- Important definitions from Management,
- Developing Objectives for Business, and their relation to important Business functions
- Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supply Chain Management, Innovation Management, Marketing and Sales
  Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management
- Definitions as information, information systems, aspects of data security and strategic information systems
- Definition and Relevance of innovations, e.g. innovation opporunities, risks etc.
- Relevance of marketing, B2B vs. B2C-Marketing
- different techniques from the field of marketing (e.g. scenario technique), pricing strategies
- important organizational structures
- basics of human ressource management
- Introduction to Business Planning and the steps of a planning process
- Decision Analysis: Elements of decision problems and methods for solving decision problems
- Selected Planning Tasks, e.g. Investment and Financial Decisions
- Introduction to Accounting: Accounting, Balance-Sheets, Costing
- Relevance of Controlling and selected Controlling methods
- Important aspects of Entrepreneurship projects

Literature:
Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008
Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003
Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006.
Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001.
Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgart 2008.
Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeine Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005.
Weber, J., Schäffer, U. : Einführung in das Controlling, 12. Auflage, Stuttgart 2008.
Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006.

Course: Project Entrepreneurship (Problemorientierte Lehrveranstaltung)

Lecturer:
Prof. Christoph Ihl

Language:
DE

Cycle:
WS/SS

Content:
In this project module, students work on an Entrepreneurship project. They are required to go through all relevant steps, from the first idea to the concept, using their knowledge from the corresponding lecture.
Project work is carried out in teams with the support of a mentor.

Literature:
Relevante Literatur aus der korrespondierenden Vorlesung.

Specialisation Energy and Enviromental Engineering

Forms of energy are used in a variety of ways in industry, domestic households and transportation, so energy is now as important a part of our daily lives as water. Increasingly, attention is paid to sustainable use of energy, without imposing long-term strains on coming generations. Cross-linked training in the foundations of and current issues around energy technology takes account of this situation. One increasingly important concern is to reduce CO_2 emissions responsible for the greenhouse effect. In pursuit of this, energy-saving opportunities are pursued and increasing use is made of regenerative energies. Though fossil fuels will still have to be used for a long time to come, efforts are made to reduce CO_2 emissions by increasing efficiency and by capturing the CO_2 their use generates and storing it underground. These processes in particular make it essential for energy engineering and environmental engineering activities to be closely linked.

Module: Mechanical Engineering: Design

Courses:

Title	Typ	Hrs/wk
Embodiment Design and 3D-CAD	Vorlesung	2
Mechanical Design Project I	Testat	3
Mechanical Design Project II	Testat	3
Team Project Design Methodology	Problemorientierte Lehrveranstaltung	2

Module Responsibility:
Prof. Dieter Krause

Admission Requirements:
None

Recommended Previous Knowledge:

- Fundamentals of Mechanical Engineering Design
- Mechanics
- Fundamentals of Materials Science
- Production Engineering

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
After passing the module, students are able to:

- explain design guidelines for machinery parts e.g. considering load situation, materials and manufacturing requirements,
- describe basics of 3D CAD,
- explain basics methods of engineering designing.

Capabilities:
After passing the module, students are able to:

- independently create sketches, technical drawings and documentations e.g. using 3D CAD,
- design components based on design guidelines autonomously,
- dimension (calculate) used components,
- use methods to design and solve engineering design tasks systamtically and solution-oriented,
- apply creativity techniques in teams.

Personal Competence:
Social Competence:
After passing the module, students are able to:

- develop and evaluate solutions in groups including making and documenting decisions,
- moderate the use of scientific methods,
- present and discuss solutions and technical drawings within groups,
- reflect the own results in the work groups of the course.

Autonomy:
Students are able

- to estimate their level of knowledge using activating methods within the lectures (e.g. with clickers),
- To solve engineering design tasks systematically.

ECTS-Credit points:
6 LP

Examination:

Klausur

Workload in Hours:

Indipendent Study Time: 40, Study Time in Lecture: 140

Assignment for the Following Curricula:

General Engineering Science (German program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Biomedical Engineering: Compulsory
Energy and Environmental Engineering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Biomedical Engineering: Compulsory
Mechanical Engineering: Kernqualifikation: Compulsory
Mechatronics: Kernqualifikation: Compulsory
Naval Architecture: Kernqualifikation: Compulsory

Course: Embodiment Design and 3D-CAD (Vorlesung)

Lecturer:

Prof. Dieter Krause

Language:

DE

Cycle:

WS

Content:

- Basics of 3D CAD technology
- Practical course to apply a 3D CAD system
  - Introduction to the system
  - Sketching and creation of components
  - Creation of assemblies
  - Deriving technical drawings

Literature:

- CAx für Ingenieure eine praxisbezogene Einführung; Vajna, S., Weber, C., Bley, H., Zeman, K.; Springer-Verlag, aktuelle Auflage.
- Handbuch Konstruktion; Rieg, F., Steinhilper, R.; Hanser; aktuelle Auflage.
- Dubbel, Taschenbuch für den Maschinenbau; Grote, K.-H., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.
- Technisches Zeichnen: Grundlagen, Normen, Beispiele, Darstellende Geometrie, Hoischen, H; Hesser, W; Cornelsen, aktuelle Auflage.
- Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.
- Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.
- Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.
- Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.
- Maschinenelemente – Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.
- Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.

Course: Mechanical Design Project I (Testat)

Lecturer:

Prof. Thorsten Schüppstuhl

Language:

DE

Cycle:

WS

Content:

- Create a technical documentation of an existing mechanical model
- Consolidation of the following aspects of technical drawings:
  - Presentation of technical objects and standardized parts
    (bearings, seals, shaft-hub joints, detachable connections, springs, axes and shafts)
  - Sectional views
  - Dimensioning
  - Tolerances and surface specifications
  - Creating a tally sheet

Literature:

1. Hoischen, H.; Hesser, W.: Technisches Zeichnen. Grundlagen, Normen, Beispiele, darstellende Geometrie, 33. Auflage. Berlin 2011.
2. Labisch, S.; Weber, C.: Technisches Zeichnen. Selbstständig lernen und effektiv üben, 4. Auflage. Wiesbaden 2008.
3. Fischer, U.: Tabellenbuch Metall, 43. Auflage. Haan-Gruiten 2005.

Course: Mechanical Design Project II (Testat)

Lecturer:
Prof. Wolfgang Hintze

Language:
DE

Cycle:
SS

Content:

- Generation of sketches for functions and sub-functions
- Approximately calculation of shafts
- Dimension of bearings, screw connections and weld
- Generation of engineering drawings (assembly drawings, manufacturing drawing)

Literature:
Dubbel, Taschenbuch für Maschinenbau, Beitz, W., Küttner, K.-H, Springer-Verlag.
Maschinenelemente, Band I - III, Niemann, G., Springer-Verlag.
Maschinen- und Konstruktionselemente, Steinhilper, W., Röper, R., Springer-Verlag.
Einführung in die DIN-Normen, Klein, M., Teubner-Verlag.
Konstruktionslehre, Pahl, G., Beitz, W., Springer-Verlag.

Course: Team Project Design Methodology (Problemorientierte Lehrveranstaltung)

Lecturer:
Prof. Dieter Krause

Language:
DE

Cycle:
SS

Content:

- Introduction to engineering designing methodology
- Team Project Design Methodology
  - Creating requirement lists
  - Problem formulation
  - Creating functional structures
  - Finding solutions
  - Evaluation of the found concepts
  - Documentation of the taken methodological steps and the concepts using presentation slides

Literature:

- Dubbel, Taschenbuch für den Maschinenbau; Grote, K.-H., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.
- Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.
- Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.
- Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.
- Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.
- Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.
- Maschinenelemente – Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.
- Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.
- Sowie weitere Bücher zu speziellen Themen

Module: Introduction into Energy and Environmental Engineering

Courses:

Title	Typ	Hrs/wk
Introduction to Energy and Environmental Engineering	Problemorientierte Lehrveranstaltung	4
Physics-Lab for VT/BVT/EUT-Engineers	Laborpraktikum	2

Module Responsibility:
Prof. Alfons Kather

Admission Requirements:
None

Recommended Previous Knowledge:
None

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students can sketch the different options for electricity and heat generation and gain insight into environmental engineering technology. They learn to name the main components of the corresponding plants. They learn to present experiences and their own observations from the praxis in a thematically specialised context.
Through a practical course in physics the students learn to deliver an overview of specialist aspects of physics

Capabilities:
Within the framework of the module the students learn the fundamentals of technical communication. In the Seminar the students learn to use oral communication for specialist themes. In the ractical course in Physics they deepen their knowledge from school physics through individual experiments with learn demonstrators. The students thus learn in addition written technical communication skills.

Personal Competence:
Social Competence:
The social skills of the students within the group but also with the isited Company are strengthened. For the preparation of the joint Seminar presentation the students learn communication and team skills.

The practical course in Physics is also carried out in groups, including the preparation of the test reports. The students strengthen further their social skills, can achieve in group common results and report them in joint protocols.

Autonomy:
In the Seminar the students learn individually to formulate conclusions realistically representing the professional praxis. In the preparation and delivery of the individual presentations the students learn to work independently on specific technical subjects and to present these to the group. The students learn within the framework of the practical course on Physics to perform experimental demonstrations and individually prepare and present a short experimental report.

ECTS-Credit points:
6 LP

Examination:
Referat

Workload in Hours:
Indipendent Study Time: 96, Study Time in Lecture: 84

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Energy and Enviromental Engineering: Compulsory
Energy and Environmental Engineering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Energy and Enviromental Engineering: Compulsory

Course: Introduction to Energy and Environmental Engineering (Problemorientierte Lehrveranstaltung)

Lecturer:
Prof. Alfons Kather

Language:
DE

Cycle:
WS

Content:
The students are divided in groups and each group visits a company from Hamburg which is active on the field of energy and environmental technology. The topics and technologies covered during the visits are then presented in Seminars. Where appropriate, the Seminars will be supplemented by lectures given by professors of the TUHH.

Some sample topics are:

- Conventional steam power plants and combined cycle power plants
- Power plant components (boiler, steam turbine, condenser, feed water heaters, etc.)
- Distributed electricity generation and energy supply
- District and neighbourhood heating networks
- Renewable energy
- Energy storage
- Electric grids
- Energy management at end-user level
- Energy-intensive industries
- Environmental technology (e.g., wastewater treatment plants)

Literature:

Keine erforderlich

Course: Physics-Lab for VT/BVT/EUT-Engineers (Laborpraktikum)

Lecturer:

Prof. Wolfgang Hansen

Language:

DE/EN

Cycle:

WS

Content:

In the physics lab a number of key experiments on physical phenomena in mechanics, oscillatory and wave motion, thermodynamics, electricity, and optics will be conducted by the students under assistance of a lecturing tutor. The experiments are part of the physics education program presented in the course "Physics for TUHH-VT Engineers".
Beyond teaching of fundamental physical background the objectives are basic skills in preparation and performing physical measurements, usage of physical equipment, analysis of the results and preparation of a report on the experimental data.

Literature:

Zu den Versuchen gibt es individuelle Versuchsanleitungen, die vor der Versuchsdurchführung ausgegeben werden.
Zum Teil müssen die zur Versuchsdurchführung notwendigen physikalischen Hintergründe selbstständig erarbeitet werden, wozu die zur Vorlesung "Physik für TUHH-VT Ingenieure" angegebene Literatur gut geeignet ist.

Courses:

Title	Typ	Hrs/wk
Fundamentals of Fluid Mechanics	Vorlesung	2
Exercises in Fluid Mechanics for Process Engineering	Hörsaalübung	1

Module Responsibility:
Prof. Michael Schlüter

Admission Requirements:

- Mathematics I+II+III
- Technical Mechanics I+II
- Technical Thermodynamics I+II

Recommended Previous Knowledge:

- Working with force balances
- Simplification and solving of partial differential equations
- Integration

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students are able to:

- explain the difference between different types of flow
- give an overview for different applications of the Reynolds Transport-Theorem in process engineering
- explain simplifications of the Continuity- and Navier-Stokes-Equation by using physical boundary conditions

Capabilities:
The students are able to

- describe and model incompressible flows mathematically
- reduce the governing equations of fluid mechanics by simplifications to archive quantitative solutions e.g. by integration
- notice the dependency between theory and technical applications
- use the learned basics for fluid dynamical applications in fields of process engineering

Personal Competence:
Social Competence:
The students

- are capable to gather information from subject related, professional publications and relate that information to the context of the lecture and
- able to work together on subject related tasks in small groups. They are able to present their results effectively in English (e.g. during small group exercises)

Autonomy:
The students are able to

- search further literature for each topic and to expand their knowledge with this literature,
- work on their exercises by their own and to evaluate their actual knowledge with the feedback.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 138, Study Time in Lecture: 42

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Chemical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (German program): Vertiefung Energy and Enviromental Engineering: Compulsory
Bioprocess Engineering: Kernqualifikation: Compulsory
Energy and Environmental Engineering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (English program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (English program): Vertiefung Chemical Engineering: Compulsory
Technomathematics: Vertiefung Engineering Science: Compulsory suffrage

Course: Fundamentals of Fluid Mechanics (Vorlesung)

Lecturer:
Prof. Michael Schlüter

Language:
DE

Cycle:
SS

Content:

- fluid properties
- hydrostatic
- overall balances - theory of streamline
- overall balances- conservation equations
- differential balances - Navier Stokes equations
- irrotational flows - Potenzialströmungen
- flow around bodies - theory of physical similarity
- turbulent flows
- compressible flows

Literature:

1. Crowe, C. T.: Engineering fluid mechanics. Wiley, New York, 2009.
2. Durst, F.: Strömungsmechanik: Einführung in die Theorie der Strömungen von Fluiden. Springer-Verlag, Berlin, Heidelberg, 2006.
3. Fox, R.W.; et al.: Introduction to Fluid Mechanics. J. Wiley & Sons, 1994
4. Herwig, H.: Strömungsmechanik: Eine Einführung in die Physik und die mathematische Modellierung von Strömungen. Springer Verlag, Berlin, Heidelberg, New York, 2006
5. Herwig, H.: Strömungsmechanik: Einführung in die Physik von technischen Strömungen: Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008
6. Kuhlmann, H.C.: Strömungsmechanik. München, Pearson Studium, 2007
7. Oertl, H.: Strömungsmechanik: Grundlagen, Grundgleichungen, Lösungsmethoden, Softwarebeispiele. Vieweg+ Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2009
8. Schade, H.; Kunz, E.: Strömungslehre. Verlag de Gruyter, Berlin, New York, 2007
9. Truckenbrodt, E.: Fluidmechanik 1: Grundlagen und elementare Strömungsvorgänge dichtebeständiger Fluide. Springer-Verlag, Berlin, Heidelberg, 2008
10. Schlichting, H. : Grenzschicht-Theorie. Springer-Verlag, Berlin, 2006
11. van Dyke, M.: An Album of Fluid Motion. The Parabolic Press, Stanford California, 1882.
12. White, F.: Fluid Mechanics, Mcgraw-Hill, ISBN-10: 0071311211, ISBN-13: 978-0071311212, 2011

Course: Exercises in Fluid Mechanics for Process Engineering (Übung)

Lecturer:
Prof. Michael Schlüter

Language:
DE

Cycle:
SS

Content:
The Exercise-Lecture will bridge the gap between the theoretical content from the lecture and the practical calculations for the homework exercises. For this aim a special exercise is calculated at the blackboard that shows how the theoretical knowledge from the lecture can be used to solve real problems in Process Engineering.

Literature:

1. Crowe, C. T.: Engineering fluid mechanics. Wiley, New York, 2009.
2. Durst, F.: Strömungsmechanik: Einführung in die Theorie der Strömungen von Fluiden. Springer-Verlag, Berlin, Heidelberg, 2006.
3. Fox, R.W.; et al.: Introduction to Fluid Mechanics. J. Wiley & Sons, 1994
4. Herwig, H.: Strömungsmechanik: Eine Einführung in die Physik und die mathematische Modellierung von Strömungen. Springer Verlag, Berlin, Heidelberg, New York, 2006
5. Herwig, H.: Strömungsmechanik: Einführung in die Physik von technischen Strömungen: Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008
6. Kuhlmann, H.C.: Strömungsmechanik. München, Pearson Studium, 2007
7. Oertl, H.: Strömungsmechanik: Grundlagen, Grundgleichungen, Lösungsmethoden, Softwarebeispiele. Vieweg+ Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2009
8. Schade, H.; Kunz, E.: Strömungslehre. Verlag de Gruyter, Berlin, New York, 2007
9. Truckenbrodt, E.: Fluidmechanik 1: Grundlagen und elementare Strömungsvorgänge dichtebeständiger Fluide. Springer-Verlag,

Berlin, Heidelberg, 2008
10. Schlichting, H. : Grenzschicht-Theorie. Springer-Verlag, Berlin, 2006
11. van Dyke, M.: An Album of Fluid Motion. The Parabolic Press, Stanford California, 1882.
12. White, F.: Fluid Mechanics, Mcgraw-Hill, ISBN-10: 0071311211, ISBN-13: 978-0071311212, 2011

Module: Electrical Machines

Courses:

Title	Typ	Hrs/wk
Electrical Machines	Vorlesung	3
Electrical Machines	Hörsaalübung	2

Module Responsibility:
Prof. Günter Ackermann

Admission Requirements:
none

Recommended Previous Knowledge:
Basics of mathematics, in particular complexe numbers, integrals, differentials
Basics of electrical engineering and mechanical engineering

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students can to draw and explain the basic principles of electric and magnetic fields.
They can describe the function of the standard types of electric machines and present the corresponding equations and characteristic curves.

Capabilities:
Students arw able to calculate two-dimensional electric and magnetic fields in particular ferromagnetic circuits with air gap. Fopr this they apply the usual methods of the design auf electric machines.
They can calulate the operational performance of electric machines from their given characteristic data and selected quantities and characteristic curves. They apply the usual equivalent circuits and graphical methods.

Personal Competence:
Social Competence:
none
Autonomy:
Students are able independently to calculate electric and magnatic fields for applications. They are able independently to analyse the operational performance of electric machines from the charactersitic data and they thereof can calculate selected quantities and characteristc curves.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 110, Study Time in Lecture: 70

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering: Compulsory suffrage
Electrical Engineering: Kernqualifikation: Compulsory suffrage
Electrical Engineering myTrack: Kernqualifikation: Compulsory suffrage
Energy and Environmental Engineering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering: Compulsory suffrage
Logistics and Mobility: Vertiefung Engineering Science: Compulsory suffrage
Mechanical Engineering: Kernqualifikation: Compulsory suffrage
Mechatronics: Kernqualifikation: Compulsory

Course: Electrical Machines (Vorlesung)

Lecturer:
Prof. Günter Ackermann

Language:
DE

Cycle:
SS

Content:

Electric field: Coulomb´s law, flux (field) line, work, potential, capacitor, energy, force
Magnetic field: force, flux line, Ampere´s law, field at bounderies, flux, magnetic circuit, hysteresis, induction, self-induction, mutual inductance, transformer
DC-Machines: Construction and layout, torque generation mechanismen, torque vs speed characteristics, commutation,
Asynchronous Machines. Magnetic field, construction and layout, equivalent single line diagram, complex stator current diagram (Heylands ´diagram), torque vs. speed characteristics, rotor layout (Squirrelcage vs. sliprings),
Synchronous machines, construction and layout, equivalent single line diagrams, no-load and short-cuircuit characteristics, vector diagrams, motor and generator operation
drives with variable speed, inverter fed operation, special drives, step motors,

Literature:

Hermann Linse, Roland Fischer: "Elektrotechnik für Maschinenbauer", Vieweg-Verlag; Signatur der Bibliothek der TUHH: ETB 313
Ralf Kories, Heinz Schmitt-Walter: "Taschenbuch der Elektrotechnik"; Verlag Harri Deutsch; Signatur der Bibliothek der TUHH: ETB 122
"Grundlagen der Elektrotechnik" - anderer Autoren
Fachbücher "Elektrische Maschinen"

Course: Electrical Machines (Übung)

Lecturer:

Prof. Günter Ackermann

Language:

DE

Cycle:

SS

Content:

Exercises to the application of electric and magnetic fields.
Excercises to the operational performance of eletric machines.

Literature:

Hermann Linse, Roland Fischer: "Elektrotechnik für Maschinenbauer", Vieweg-Verlag; Signatur der Bibliothek der TUHH: ETB 313
Ralf Kories, Heinz Schmitt-Walter: "Taschenbuch der Elektrotechnik"; Verlag Harri Deutsch; Signatur der Bibliothek der TUHH: ETB 122
"Grundlagen der Elektrotechnik" - anderer Autoren
Fachbücher "Elektrische Maschinen"

Module: Renewables and Energy Systems

Courses:

Title	Typ	Hrs/wk
Power Industry	Vorlesung	1
Energy Systems and Energy Industry	Vorlesung	2
Renewable Energy	Vorlesung	2
Renewable Energy	Gruppenübung	1

Module Responsibility:
Prof. Martin Kaltschmitt

Admission Requirements:
none

Recommended Previous Knowledge:
none

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
With completion of this module, the students can provide an overview of characteristics of energy systems and their economic efficiency. They can explain the issues occurring in this context. Furthermore, they can explain details of power generation, power distribution and power trading wih regard to subject-related contexts. The students can explain these aspects, which are applicable to many energy systems in general, especially for renewable energy systems and critical discuss it.

Capabilities:
Students are able to apply methodologies for detailed determination of energy demand or energy production for various types of energy systems. Furthermore, they can evaluate energy systems technically, environmentally and economically and design them under certain given conditions. Therefore, they can choose the necessary subject-specific calculation rules, also for not standardized solutions of a problem.

Personal Competence:
Social Competence:
Autonomy:
Students can independently exploit sources , acquire the particular knowledge about the subject area and transform it to new questions.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 96, Study Time in Lecture: 84

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Energy and Enviromental Engineering: Compulsory
Energy and Environmental Engineering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Energy and Enviromental Engineering: Compulsory

Course: Power Industry (Vorlesung)

Lecturer:
Prof. Martin Kaltschmitt, Dr. Andreas Wiese

Language:
DE

Cycle:
SS

Content:

- Electrical energy in the energy system
- Demand and use of electrical energy (households, industry, "new" buyers (including e-mobility))
- Electricity generation
  - electricity generation technologies using fossil fuels and their characteristics
  - combined heat and power technologies and their production characteristics
  - electricity generation from renewable energy technologies and their characteristics
- Power distribution
  - "classic" distribution of electrical energy
  - challenges of fluctuating electricity generation by distributed systems (electricity market, electricity stock exchange, emissions

trading)
- District heating industry
- Legal and administrative aspects
  - Energy Act
  - support instruments for renewable energy
  - CHP Act
- Cost and efficiency calculation

Literature:
Folien der Vorlesung

Course: Energy Systems and Energy Industry (Vorlesung)

Lecturer:
Prof. Martin Kaltschmitt

Language:
DE

Cycle:
SS

Content:

- Energy: development and significance
- Fundamentals and basic concepts
- Energy demand and future trends (heat, electricity, fuels)
- Energy reserve and sources
- Cost and efficiency calculation
- Final and effective energy from petroleum, natural gas, coal, uranium and other
- Legal, administrative and organizational aspects of energy systems
- Energy systems as a permanent optimization task

Literature:

- Kopien der Folien

Course: Renewable Energy (Vorlesung)

Lecturer:
Prof. Martin Kaltschmitt

Language:
DE/EN

Cycle:
SS

Content:

- introduction
- solar energy for heat and power generation
- wind power for electricity generation
- hydropower for electricity generation
- ocean energy for electricity generation
- geothermal energy for heat and electricty generation

Literature:

- Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien – Systemtechnik, Wirtschaftlichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage
- Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy – Technology, Economics and Environment; Springer, Berlin, Heidelberg,2007

Course: Renewable Energy (Übung)

Lecturer:
Prof. Martin Kaltschmitt

Language:
DE/EN

Cycle:
SS

Content:

- Solar thermal heat
- Concentrating solare power
- Photovoltaic
- Windenergie
- Hydropower
- Heat pump
- Deep geothermal energy

Literature:

- Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien – Systemtechnik, Wirtschaftlichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage
- Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy – Technology, Economics and Environment; Springer, Berlin, Heidelberg,2007

Courses:

Title	Typ	Hrs/wk
Introduction to Management	Vorlesung	4
Project Entrepreneurship	Problemorientierte Lehrveranstaltung	2

Module Responsibility:
Prof. Kathrin Fischer

Admission Requirements:
None

Recommended Previous Knowledge:
Basic Knowledge of Mathematics and Business

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
After taking this module, students know the important basics of many different areas in Business and Management, from Planning and Organisation to Marketing and Innovation, and also to Investment and Controlling. In particular they are able to

- explain the differences between Economics and Management and the sub-disciplines in Management and to name important definitions from the field of Management
- explain the most important aspects of and goals in Management and name the most important aspects of entreprneurial projects
- describe and explain basic business functions as production, procurement and sourcing, supply chain management, organization and human ressource management, information management, innovation management and marketing
- explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives and uncertainty, and explain some basic methods from mathematical Finance
- state basics from accounting and costing and selected controlling methods.

Capabilities:
Students are able to analyse business units with respect to different criteria (organization, objectives, strategies etc.) and to carry out an Entrepreneurship project in a team. In particular, they are able to

- analyse Management goals and structure them appropriately
- analyse organisational and staff structures of companies
- apply methods for decision making under multiple objectives, under uncertainty and under risk
- analyse production and procurement systems and Business information systems
- analyse and apply basic methods of marketing
- select and apply basic methods from mathematical finance to predefined problems
- apply basic methods from accounting, costing and controlling to predefined problems

Personal Competence:
Social Competence:
Students are able to

- work successfully in a team of students
- to apply their knowledge from the lecture to an entrepreneurship project and write a coherent report on the project
- to communicate appropriately and
- to cooperate respectfully with their fellow students.

Autonomy:
Students are able to

- work in a team and to organize the team themselves
- to write a report on their project.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 96, Study Time in Lecture: 84

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Electrical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Computer Science and Engineering: Compulsory
General Engineering Science (German program): Vertiefung Chemical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Bioprocess Engineering: Compulsory

General Engineering Science (German program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (German program): Vertiefung Civil- and Enviromental Engeneering: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Naval Architecture: Compulsory
Civil- and Environmental Engeneering: Kernqualifikation: Compulsory
Bioprocess Engineering: Kernqualifikation: Compulsory
Computer Science: Kernqualifikation: Compulsory
Electrical Engineering: Kernqualifikation: Compulsory
Electrical Engineering myTrack: Kernqualifikation: Compulsory
Energy and Environmental Engineering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Civil- and Enviromental Engeneering: Compulsory
General Engineering Science (English program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (English program): Vertiefung Electrical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (English program): Vertiefung Computer Science and Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Naval Architecture: Compulsory
General Engineering Science (English program): Vertiefung Chemical Engineering: Compulsory
Computational Science and Engineering: Kernqualifikation: Compulsory
Logistics and Mobility: Kernqualifikation: Compulsory
Mechanical Engineering: Kernqualifikation: Compulsory
Mechatronics: Kernqualifikation: Compulsory
Naval Architecture: Kernqualifikation: Compulsory
Technomathematics: Kernqualifikation: Compulsory
Process Engineering: Kernqualifikation: Compulsory

Course: Introduction to Management (Vorlesung)

Lecturer:
Prof. Kathrin Fischer, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Cornelius Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona

Language:
DE

Cycle:
WS/SS

Content:

- Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management
- Important definitions from Management,
- Developing Objectives for Business, and their relation to important Business functions
- Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supply Chain Management, Innovation Management, Marketing and Sales
  Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management
- Definitions as information, information systems, aspects of data security and strategic information systems
- Definition and Relevance of innovations, e.g. innovation opporunities, risks etc.
- Relevance of marketing, B2B vs. B2C-Marketing
- different techniques from the field of marketing (e.g. scenario technique), pricing strategies
- important organizational structures
- basics of human ressource management
- Introduction to Business Planning and the steps of a planning process
- Decision Analysis: Elements of decision problems and methods for solving decision problems
- Selected Planning Tasks, e.g. Investment and Financial Decisions
- Introduction to Accounting: Accounting, Balance-Sheets, Costing
- Relevance of Controlling and selected Controlling methods
- Important aspects of Entrepreneurship projects

Literature:
Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008
Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003
Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006.
Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001.
Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgart 2008.
Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeine Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005.
Weber, J., Schäffer, U. : Einführung in das Controlling, 12. Auflage, Stuttgart 2008.
Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006.

Course: Project Entrepreneurship (Problemorientierte Lehrveranstaltung)

Lecturer:
Prof. Christoph Ihl

Language:
DE

Cycle:
WS/SS

Content:
In this project module, students work on an Entrepreneurship project. They are required to go through all relevant steps, from the first idea to the concept, using their knowledge from the corresponding lecture.
Project work is carried out in teams with the support of a mentor.

Literature:
Relevante Literatur aus der korrespondierenden Vorlesung.

Courses:

Title	Typ	Hrs/wk
Heat and Mass Transfer	Vorlesung	2
Heat and Mass Transfer	Gruppenübung	1

Module Responsibility:
Prof. Irina Smirnova

Admission Requirements:

Recommended Previous Knowledge:
Basic knowledge: Technical Thermodynamics

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:

- The students are capable of explaining qualitative and determining quantitative heat transfer in procedural apparatus (e. g. heat exchanger, chemical reactors).
- They are capable of distinguish and characterize different kinds of heat transfer mechanisms namely heat conduction, heat transfer and thermal radiation.
- The students have the ability to explain the physical basis for mass transfer in detail and to describe mass transfer qualitative and quantitative by using suitable mass transfer theories.
- They are able to depict the analogy between heat- and mass transfer and to describe complex linked processes in detail.

Capabilities:

- The students are able to set reasonable system boundaries for a given transport problem by using the gained knowledge and to balance the corresponding energy and mass flow, respectively.
- They are capable to solve specific heat transfer problems (e.g. heated chemical reactors, temperature alteration in fluids) and to calculate the corresponding heat flows.
- Using dimensionless quantities, the students can execute scaling up of technical processes or apparatus.
- They are able to distinguish between diffusion, convective mass transition and mass transfer. They can use this knowledge for the description and design of apparatus (e.g. extraction column, rectification column).
- In this context, the students are capable to choose and design fundamental types of heat and mass exchanger for a specific application considering their advantages and disadvantages, respectively.
- In addition, they can calculate both, steady-state and non-steady-state processes in procedural apparatus.
- The students are capable to connect their knowledge obtained in this course with knowlegde of other courses (In particular the courses thermodynamics, fluid mechanics and chemical process engineering) to solve concrete technical problems.

Personal Competence:
Social Competence:

- The students are capable to work on subject-specific challenges in teams and to present the results in a reasonable manner.

Autonomy:

- The students are able to find and evaluate necessary information from suitable sources
- They are able to prove their level of knowledge during the course with accompanying procedure continuously (clicker-system, exam-like assignments) and on this basis they can control their learning processes.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 138, Study Time in Lecture: 42

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Chemical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (German program): Vertiefung Energy and Enviromental Engineering: Compulsory

Bioprocess Engineering: Kernqualifikation: Compulsory
Energy and Environmental Engineering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (English program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (English program): Vertiefung Chemical Engineering: Compulsory
Technomathematics: Kernqualifikation: Compulsory suffrage
Process Engineering: Kernqualifikation: Compulsory

Course: Heat and Mass Transfer (Vorlesung)

Lecturer:
Prof. Irina Smirnova

Language:
DE

Cycle:
WS

Content:

1. Heat transfer
    - Introduction, one-dimensional heat conduction
    - Convective heat transfer
    - Multidimensional heat conduction
    - Non-steady heat conduction
    - Thermal radiation
2. Mass transfer
    - one-way diffusion, equimolar countercurrent diffusion
    - boundary layer theory, non-steady mass transfer
    - Heat and mass transfer single particle/ fixed bed
    - Mass transfer and chemical reactions

Literature:

1. H.D. Baehr und K. Stephan: Wärme- und Stoffübertragung, Springer
2. VDI-Wärmeatlas

Course: Heat and Mass Transfer (Übung)

Lecturer:
Prof. Irina Smirnova

Language:
DE

Cycle:
WS

Content:

1. Heat transfer
    - Introduction, one-dimensional heat conduction
    - Convective heat transfer
    - Multidimensional heat conduction
    - Non-steady heat conduction
    - Thermal radiation
2. Mass transfer
    - one-way diffusion, equimolar countercurrent diffusion
    - boundary layer theory, non-steady mass transfer
    - Heat and mass transfer single particle/ fixed bed
    - Mass transfer and chemical reactions

Literature:

1. H.D. Baehr und K. Stephan: Wärme- und Stoffübertragung, Springer
2. VDI-Wärmeatlas

Courses:

Title	Typ	Hrs/wk
Thermal Separation Processes	Vorlesung	3
Thermal Separation Processes	Gruppenübung	2
Thermal Separation Processes	Hörsaalübung	1
Separation Processes	Laborpraktikum	1

Module Responsibility:
Prof. Irina Smirnova

Admission Requirements:
Recommended requirements: Thermodynamics III (not compulsory)

Recommended Previous Knowledge:
Recommended requirements: Thermodynamics III

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:

- The students develop an understanding of separation processes of fluid mixtures
- They can distinguish and describe different types of separation processes such as distillation, extraction or adsorption
- The students have good knowledge of designing methods for separation processes and devices
- The students develop an understanding for the course of concentration changes during a separation process, the estimation of the energy demand of a process, the possibilities of energy saving and the selection of separation systems

Capabilities:

- Using the gained knowledge the students can select a reasonable system boundary for a given separation process and can close the associated energy and material balances
- The students can use different graphical methods for the designing of a separation process and define the amount of theoretical stages required
- They can select and design a basic type of thermal separation process for a given case based on the advantages and disadvantages of the process
- The students are capable to obtain independently the needed material properties from appropriate sources (diagrams and tables)
- They can calculate continuous and discontinuous processes

The students are capable of linking their gained knowledge with the content of other lectures and use it together for the solution of technical problems. Other lectures such as thermodynamics, fluid mechanics and chemical engineering.

Personal Competence:
Social Competence:

- The students can work technical assignments in small groups and present the combined results in the tutorial

Autonomy:

- The students are capable to obtain the needed information from suitable sources by themselves and assess their quality
- The students can proof the state of their knowledge with exam resembling assignments and in this way control their learning process

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 82, Study Time in Lecture: 98

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Chemical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (German program): Vertiefung Energy and Enviromental Engineering: Compulsory
Bioprocess Engineering: Kernqualifikation: Compulsory

Energy and Environmental Engineering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (English program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (English program): Vertiefung Chemical Engineering: Compulsory
Process Engineering: Kernqualifikation: Compulsory

Course: Thermal Separation Processes (Vorlesung)

Lecturer:
Prof. Irina Smirnova

Language:
DE

Cycle:
WS

Content:

- Introduction in the thermal process engineering and to the main features of separation processes
- Simple equilibrium processes, several steps processes
- Distillation of binary mixtures, enthalpy-concentration diagrams
- Extractive and azeotrope distillation, water vapor distillation, stepwise distillation
- Extraction: separation ternary systems, ternary diagram
- Multiphase separation including complex mixtures
- Designing of separation devices without discrete stages
- Drying
- Chromatographic separation processes
- Membrane separation
- Energy demand of separation processes
- Advance overview of separation processes
- Selection of separation processes

Literature:

- G. Brunner: Skriptum Thermische Verfahrenstechnik
- J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980
- Sattler: Thermische Trennverfahren, VCH, Weinheim 1995
- J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998.
- Mersmann: Thermische Verfahrenstechnik, Springer, 1980
- Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997
- Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1 ; ISBN 0-387-91477-3 .
- R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006.
    - Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed., McGraw-Hill, New York 1984 Ullmann"s Enzyklopädie der Technischen Chemie

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Course: Thermal Separation Processes (Übung)

Lecturer:
Prof. Irina Smirnova

Language:
DE

Cycle:
WS

Content:

- Introduction in the thermal process engineering and to the main features of separation processes
- Simple equilibrium processes, several steps processes
- Distillation of binary mixtures, enthalpy-concentration diagrams
- Extractive and azeotrope distillation, water vapor distillation, stepwise distillation
- Extraction: separation ternary systems, ternary diagram
- Multiphase separation including complex mixtures
- Designing of separation devices without discrete stages
- Drying
- Chromatographic separation processes
- Membrane separation
- Energy demand of separation processes
- Advance overview of separation processes

- Selection of separation processes

Literature:

- G. Brunner: Skriptum Thermische Verfahrenstechnik
- J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980
- Sattler: Thermische Trennverfahren, VCH, Weinheim 1995
- J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998.
- Mersmann: Thermische Verfahrenstechnik, Springer, 1980
- Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997
- Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1 ; ISBN 0-387-91477-3 .
- R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006.
- Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed., McGraw-Hill, New York 1984 Ullmann"s Enzyklopädie der Technischen Chemie

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Course: Thermal Separation Processes (Übung)

Lecturer:
Prof. Irina Smirnova

Language:
DE

Cycle:
WS

Content:

- Introduction in the thermal process engineering and to the main features of separation processes
- Simple equilibrium processes, several steps processes
- Distillation of binary mixtures, enthalpy-concentration diagrams
- Extractive and azeotrope distillation, water vapor distillation, stepwise distillation
- Extraction: separation ternary systems, ternary diagram
- Multiphase separation including complex mixtures
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- Membrane separation
- Energy demand of separation processes
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Literature:

- G. Brunner: Skriptum Thermische Verfahrenstechnik
- J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980
- Sattler: Thermische Trennverfahren, VCH, Weinheim 1995
- J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998.
- Mersmann: Thermische Verfahrenstechnik, Springer, 1980
- Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997
- Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1 ; ISBN 0-387-91477-3 .
- R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006.
- Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed., McGraw-Hill, New York 1984 Ullmann"s Enzyklopädie der Technischen Chemie

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Course: Separation Processes (Laborpraktikum)

Lecturer:
Prof. Irina Smirnova

Language:
DE/EN

Cycle:
SS

Content:

- Introduction in the thermal process engineering and to the main features of separation processes
- Simple equilibrium processes, several steps processes
- Distillation of binary mixtures, enthalpy-concentration diagrams
- Extractive and azeotrope distillation, water vapor distillation, stepwise distillation
- Extraction: separation ternary systems, ternary diagram
- Multiphase separation including complex mixtures
- Designing of separation devices without discrete stages
- Drying
- Chromatographic separation processes
- Membrane separation
- Energy demand of separation processes
- Advance overview of separation processes
- Selection of separation processes

Literature:

- G. Brunner: Skriptum Thermische Verfahrenstechnik
- J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980
- Sattler: Thermische Trennverfahren, VCH, Weinheim 1995
- J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998.
- Mersmann: Thermische Verfahrenstechnik, Springer, 1980
- Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997
- Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1 ; ISBN 0-387-91477-3 .
- R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006.
- Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed., McGraw-Hill, New York 1984 Ullmann"s Enzyklopädie der Technischen Chemie

Module: Gas and Steam Power Plants

Courses:

Title	Typ	Hrs/wk
Gas and Steam Power Plants	Vorlesung	3
Gas and Steam Power Plants	Hörsaalübung	2

Module Responsibility:
Prof. Alfons Kather

Admission Requirements:

- "Technical Thermodynamics I and II"
- "Heat Transfer"
- "Fluid Mechanics"

Recommended Previous Knowledge:
Knowledge in Thermodynamics incl. Combustion Calculations, Heat Transfer and Fluid Mechanics

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students can evaluate the development of the electricity demand and the energy conversion routes in the thermal power plant, describe the various types of power plant and the layout of the steam generatorblock and determine the operation characteristics of the power plant. Additionally they can describe the exhaust gas cleaning apparatus and the combination possibilities of conventional fossil-fuelled power plants with solar thermal and geothermal power plants or plants equipped with Carbon Capture and Storage.
Capabilities:
The students will be able, using theories and methods of the energy technology from fossil fuels and based on deep knowledge on the function and construction of gas and steam power plants, to identify basic associations in the production of heat and electricity, so as to develop conceptional solutions. Through analysis of the problem and exposure to the inherent interconnections between heat and power generation, will endow the students with the capability and methodology to develop realistic optimal concepts for the generation of electricity and the production of heat. From the technical basics the students become the ability to follow better the deliberations on the electricity mix composition within the energy-political triangle (economy, secure supply and environmental protection).
Within the framework of the exercise the students learn the use of the specialised software suite EBSILON Professional^{TM}. With this tool small tasks are solved on the PC, to highlight aspects of the design and development of power plant cycles.

Personal Competence:
Social Competence:
A multi-day excursion within the framework of the lecture is planned for those students that are interested. The students thus get direct contact with the whole subject field of gas and steam power plants. Through discussions with the plant personnel the students are able to obtain an overview on daily operation problems and their solution approach.

Autonomy:
The students assisted by the tutors will be able to develop alone simple simulation models and run with these scenario analyses. In this manner the theoretical and practical knowledge from the lecture is consolidated and the potential effects from different process combinations and boundary conditions highlighted. The students are able independently to analyse the operational performance of steam power plants and calculate selected quantities and characteristc curves.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 110, Study Time in Lecture: 70

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Energy Systems: Compulsory
Energy and Environmental Engineering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Energy Systems: Compulsory
Mechanical Engineering: Vertiefung Energy Systems: Compulsory

Course: Gas and Steam Power Plants (Vorlesung)

Lecturer:

Prof. Alfons Kather

Language:
DE

Cycle:
WS

Content:
In the 1st part of the lecture an overview on thermal power plants is offered, including:

- Electricity demand and Forecasting
- Thermodynamic fundamentals
- Energy Conversion in thermal power plants
- Types of power plant
- Layout of the power plant block
- Individual elements of the power plant
- Cooling systems
- Flue gas cleaning
- Operation characteristics of the power plant
- Construction materials for power plants
- Location of power plants
- Solar shermal plants/geothermal plants/Carbon Capture and Storage plants

These are complemented in the 2nd part of the module by the more specialised issues:

- Energy balance of a fluid-flow machine
- Theory of turbine and compressor stage
- Equal and positive pressure blading
- Flow losses
- Characteristic numbers
- Axial and radial design
- Design features
- Hydraulic fluid-flow machines
- Pump and water turbine designs
- Design examples of reciprocating engines and turbomachinery
- Steam power plants
- Gas turbine systems

Literature:

- Kalide: Kraft- und Arbeitsmaschinen
- Thomas, H.J.: Thermische Kraftanlagen. Springer-Verlag, 1985
- Strauß, K.: Kraftwerkstechnik. Springer-Verlag, 2006
- Kugeler und Phlippen: Energietechnik. Springer-Verlag, 1990
- T. Bohn (Hrsg.): Handbuchreihe Energie, Band 7: Gasturbinenkraftwerke, Kombikraftwerke, Heizkraftwerke und Industriekraftwerke, Technischer Verlag Resch / Verlag TÜV Rheinland

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Course: Gas and Steam Power Plants (Übung)

Lecturer:
Prof. Alfons Kather

Language:
DE

Cycle:
WS

Content:
In the 1st part of the lecture a general introduction into fluid-flow machines and steam power plants is offered, including:

- Energy balance of a fluid-flow machine
- Theory of turbine and compressor stage
- Equal and positive pressure blading
- Flow losses
- Characteristic numbers
- Axial and radial design
- Design features
- Hydraulic fluid-flow machines
- Pump and water turbine designs
- Design examples of reciprocating engines and turbomachinery
- Steam power plants

- Gas turbine systems
- Diesel engine systems
- Waste heat utilisation

followed by the more specialised issues:

- Electricity Demand and Forecasting
- Thermodynamic fundamentals
- Energy Conversion in Thermal Power Plants
- Types of Power Plant
- Layout of the power plant block
- Individual elements of the power plant
- Cooling systems
- Flue gas cleaning
- Operation characteristics of the power plant
- Construction materials
- Location of power plants

Literature:

- Skripte
- Kalide: Kraft- und Arbeitsmaschinen
- Thomas, H.J.: Thermische Kraftanlagen. Springer-Verlag, 1985
- Strauß, K.: Kraftwerkstechnik. Springer-Verlag, 2006
- Kugeler und Phlippen: Energietechnik. Springer-Verlag, 1990
- T. Bohn (Hrsg.): Handbuchreihe Energie, Band 7: Gasturbinenkraftwerke, Kombikraftwerke, Heizkraftwerke und Industriekraftwerke, Technischer Verlag Resch / Verlag TÜV Rheinland

Module: Environmental Assessment and Environmental Technology

Courses:

Title	Typ	Hrs/wk
Practical Exercise Environmental Technology	Laborpraktikum	1
Environmental Assessment	Vorlesung	2
Environmental Assessment	Gruppenübung	1
Environmental Technologie	Vorlesung	2

Module Responsibility:
Dr. Joachim Gerth

Admission Requirements:
none

Recommended Previous Knowledge:
Fundamentals of inorganic/organic chemistry and biology

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
With the completion of this modul the students obtain profound knowledge of environmental technology. They are able to describe the behaviour of chemicals in the environment. Students can give an overview of scientific disciplines involved. They can explain terms and allocate them to related methods. Students have acquired knowledge of methods to assess products, processes and locations, their characteristics and functioning of such systems. They understand the assessment of different approaches for solutions within a multidimensional decision area.

Capabilities:
Students are able to propose appropriate management and mitigation measures for environmental problems. They are able to use the computer codes UMBERTO and CONSIDEO to carry out a life cycle assessment and a sensitivity analysis independently. The students are able to work out well founded opinions on how Environmental Assessment contributes to sustainable development, and they can present and defend these opinons as against the group.

Personal Competence:
Social Competence:
Students can discuss technical and scientific tasks within a seminar subject specific and interdisciplinary .
Autonomy:
Students can independently exploit sources about of the subject, acquire the particular knowledge and tranfer it to new problems.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 96, Study Time in Lecture: 84

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Energy and Enviromental Engineering: Compulsory
Energy and Environmental Engineering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Energy and Enviromental Engineering: Compulsory

Course: Practical Exercise Environmental Technology (Laborpraktikum)

Lecturer:
Dr. Joachim Gerth

Language:
DE

Cycle:
SS

Content:
The experiment demonstrates the effect of ionic strength on the binding of dissolved zinc and phosphate by soil surfaces. From the results it can be inferred that the potential of soil surfaces is modified by the application of salt. This has consequences for the retention of nutrients and pollutants. The experiment is carried out with iron oxide rich soil material.

Literature:
F. Scheffer und P. Schachtschabel (2002): "Lehrbuch der Bodenkunde" TUB Signatur AGG-308
W.E.H. Blum (2007): "Bodenkunde in Stichworten" TUB Signatur AGG-317
C. A. J. Appelo; D. Postma (2005): "Geochemistry, groundwater and pollution"

Course: Environmental Assessment (Vorlesung)

Lecturer:
Prof. Martin Kaltschmitt, Dr. Wolfgang Ahlf, Jana Weinberg

Language:
DE/EN

Cycle:
SS

Content:
Contaminants: Impact- and Risk Assessment
Environmental damage & precautionary principle: Environmental Risk Assessment (ERA)
Resource and water consumption: Material flow analysis
Energy consumption: Cumulated energy demand (CED), cost analysis
Life cycle concept: Life cycle assessment (LCA)
Sustainability: Comprehensive product system assessment , SEE-Balance
Management: Environmental and Sustainability management (EMAS)
Complex systems: MCDA and scenario method

Literature:
Foliensätze der Vorlesung
Studie: **Instrumente zur Nachhaltigkeitsbewertung -** Eine Synopse (Forschungszentrum Jülich GmbH)

Course: Environmental Assessment (Übung)

Lecturer:
Prof. Martin Kaltschmitt, Dr. Wolfgang Ahlf

Language:
DE

Cycle:
SS

Content:
Presentation and application of free software programs in order to understand the concepts of environmental assessment methods better.

Literature:
Power point Präsentationen

Course: Environmental Technologie (Vorlesung)

Lecturer:
Prof. Kerstin Kuchta, Dr. Wolfgang Ahlf

Language:
DE

Cycle:
WS

Content:

1. Introductory seminar on environmental science:
2. Environmental impact and adverse effects
3. Wastewater technology
4. Air pollution control
5. Noise protection
6. Waste and recycling management
7. Soil and ground water protection
8. Renewable energies
9. Resource conservation and energy efficiency

Literature:
Förster, U.: Umweltschutztechnik; 2012; Springer Berlin (Verlag) 8., Aufl. 2012; 978-3-642-22972-5 (ISBN)

Module: Fundamentals of Materials Science

Courses:

Title	Typ	Hrs/wk
Fundamentals of Materials Science I	Vorlesung	2
Fundamentals of Materials Science II (Advanced Ceramic Materials, Polymers and Composites)	Vorlesung	2
Physical and Chemical Basics of Materials Science	Vorlesung	2

Module Responsibility:
Prof. Jörg Weißmüller

Admission Requirements:
None

Recommended Previous Knowledge:
Highschool-level physics, chemistry und mathematics

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students have acquired a fundamental knowledge on metals, ceramics and polymers and can describe this knowledge comprehensively. Fundamental knowledge here means specifically the issues of atomic structure, microstructure, phase diagrams, phase transformations, corrosion and mechanical properties. The students know about the key aspects of characterization methods for materials and can identify relevant approaches for characterizing specific properties. They are able to trace materials phenomena back to the underlying physical and chemical laws of nature.

Capabilities:
The students are able to trace materials phenomena back to the underlying physical and chemical laws of nature. Materials phenomena here refers to mechanical properties such as strength, ductility, and stiffness, chemical properties such as corrosion resistance, and to phase transformations such as solidification, precipitation, or melting. The students can explain the relation between processing conditions and the materials microstructure, and they can account for the impact of microstructure on the material's behavior.

Personal Competence:
Social Competence:
-
Autonomy:
-

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 96, Study Time in Lecture: 84

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Naval Architecture: Compulsory
Energy and Environmental Engineering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Naval Architecture: Compulsory
Logistics and Mobility: Vertiefung Engineering Science: Compulsory suffrage
Mechanical Engineering: Kernqualifikation: Compulsory
Mechatronics: Kernqualifikation: Compulsory
Naval Architecture: Kernqualifikation: Compulsory
Technomathematics: Vertiefung Engineering Science: Compulsory suffrage

Course: Fundamentals of Materials Science I (Vorlesung)

Lecturer:
Prof. Jörg Weißmüller

Language:

DE

Cycle:
WS

Content:

Literature:
Vorlesungsskript
W.D. Callister: Materials Science and Engineering - An Introduction. 5th ed., John Wiley & Sons, Inc., New York, 2000, ISBN 0-471-32013-7

Course: Fundamentals of Materials Science II (Advanced Ceramic Materials, Polymers and Composites) (Vorlesung)

Lecturer:
Prof. Bodo Fiedler, Prof. Gerold Schneider

Language:
DE

Cycle:
SS

Content:
Chemische Bindungen und Aufbau von Festkörpern; Kristallaufbau; Werkstoffprüfung; Schweißbarkeit; Herstellung von Keramiken; Aufbau und Eigenschaften der Keramik; Herstellung, Aufbau und Eigenschaften von Gläsern; Polymerwerkstoffe, Makromolekularer Aufbau; Struktur und Eigenschaften der Polymere; Polymerverarbeitung; Verbundwerkstoffe

Literature:
Vorlesungsskript
W.D. Callister: Materials Science and Engineering -An Introduction-5th ed., John Wiley & Sons, Inc., New York, 2000, ISBN 0-471-32013-7

Course: Physical and Chemical Basics of Materials Science (Vorlesung)

Lecturer:
Prof. Stefan Müller

Language:
DE

Cycle:
WS

Content:

Literature:
Für den **Elektromagnetismus:**

- Bergmann-Schäfer: „Lehrbuch der Experimentalphysik“, Band 2: „Elektromagnetismus“, de Gruyter

Für die **Atomphysik:**

- Haken, Wolf: „Atom- und Quantenphysik“, Springer

Für die **Materialphysik und Elastizität:**

- Hornbogen, Warlimont: „Metallkunde“, Springer

Module: Measurement Technology for Mechanical and Process Engineers

Courses:

Title	Typ	Hrs/wk
Practical Course: Measurement and Control Systems	Laborpraktikum	2
Measurement Technology for Mechanical and Process Engineers	Vorlesung	2
Measurement Technology for Mechanical and Process Engineers	Hörsaalübung	1

Module Responsibility:
NN

Admission Requirements:
none

Recommended Previous Knowledge:
Basic knowledge of physics, chemistry and electrical engineering

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students are able to name the most important fundmentals of the Measurement Technology (Quantities and Units, Uncertainty, Calibration, Static and Dynamic Properties of Sensors and Systems).
They can outline the most important measuring methods for different kinds of quantities to be maesured (Electrical Quantities, Temperature, mechanical quantities, Flow, Time, Frequency).
They can describe important methods of chemical Analysis (Gas Sensors, Spectroscopy, Gas Chromatography)

Capabilities:
Students can select suitable measuring methods to given problems and can use refering measurement devices in practice.

Personal Competence:
Social Competence:
Students can arrive at work results in groups and document them in a common report.

Autonomy:
Students are able to familiarize themselves with new measurement technologies.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 110, Study Time in Lecture: 70

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Biomedical Engineering: Compulsory
Energy and Environmental Engineering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Biomedical Engineering: Compulsory
Mechanical Engineering: Kernqualifikation: Compulsory
Mechatronics: Kernqualifikation: Compulsory

Course: Practical Course: Measurement and Control Systems (Laborpraktikum)

Lecturer:
NN

Language:
DE

Cycle:
WS/SS

Content:
Experiment 1: Emission and immission measurement of gaseous pollutants: different technologies to determine different gaseous pollutants in automotive exhaust are used.
Experiment 2: Simulation and measurement of asynchrone engine and rotary pump: the dynamic behaviour of e pump engine will be investigated. The starting will be simulated on a PC and compared with measurement.
Experiment 3: Michelson interferometer and fiber optic: fundamental optical phenonema will be understood and applications with Michelson

interferometer and optical fibers demonstrated.
Experiment 4:Identification of the parameters of a control system and optimal control parameters

Literature:

Versuch 1:

- Leith, W.: Die Analyse der Luft und ihrer Verunreinigung in der freien Atmosphäre und am Arbeitsplatz. 2. Aufl., Wissenschaftliche Verlagsgesellschaft, Stuttgart, 1974
- Birkle, M.: Meßtechnik für den Immissionsschutz, Messen der gas- und partikelförmigen Luftverunreinigungen. R. Oldenburg Verlag, München-Wien, 1979
- Luftbericht 83/84, Freie und Hansestadt Hamburg, Behörde für Bezirksangelegenheiten, Naturschutz und Umweltgestaltung
- Gebrauchs- und Bedienungsanweisungen
- VDI-Handbuch Reinhaltung der Luft, Band 5: VDI-Richtlinien 2450 Bl.1, 2451 Bl.4, 2453 Bl.5, 2455 Bl.1

Versuch 2:

- Grundlagen über elektrische Maschinen, speziell: Asynchronmotoren
- Simulationsmethoden, speziell: Verwendung von Blockschaltbildern
- Betriebsverhalten von Kreispumpen, speziell: Kennlinien, Ähnlichkeitsgesetze

Versuch 3:

- Unger, H.-G.: Optische Nachrichtentechnik, Teil 1: Optische Wellenleiter. Hüthing Verlag, Heidelberg, 1984
- Dakin, J., Cushaw, B.: Optical Fibre Sensors: Principles and Components. Artech House Boston, 1988
- Culshaw, B., Dakin, J.: Optical Fibre Sensors: Systems and Application. Artech House Boston, 1989

Versuch 4:

- Leonhard: Einführung in die Regelungstechnik. Vieweg Verlag, Braunschweig-Wiesbaden
- Jan Lunze: Systemtheoretische Grundlagen, Analyse und Entwurf einschleifiger Regelungen

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Course: Measurement Technology for Mechanical and Process Engineers (Vorlesung)

Lecturer:
NN

Language:
DE

Cycle:
WS

Content:
1 Fundamentals
1.1 Quantities and Units
1.2 Uncertainty
1.3 Calibration
1.4 Static and Dynamic Properties of Sensors and Systems
2 Measurement of Electrical Quantities
2.1 Current and Voltage
2.2 Impedance
2.3 Amplification
2.4 Oscilloscope
2.5 Analog-to-Digital Conversion
2.6 Data Transmission
3 Measurement of Nonelectric Quantities
3.1 Temperature
3.2 Length, Displacement, Angle
3.3 Strain, Force, Pressure
3.4 Flow
3.5 Time, Frequency
4 Chemical Analysis
4.1 Gas Sensors
4.2 Spectroscopy
4.3 Gas Chromatography

Literature:
Lerch, R.: „Elektrische Messtechnik; Analoge, digitale und computergestützte Verfahren“, Springer, 2006, ISBN: 978-3-540-34055-3.
Profos, P. Pfeifer, T.: „Handbuch der industriellen Messtechnik“, Oldenbourg, 2002, ISBN: 978-3486217940.

Course: Measurement Technology for Mechanical and Process Engineers (Übung)

Lecturer:

NN

Language:

DE

Cycle:

WS

Content:

1 Fundamentals
1.1 Quantities and Units
1.2 Uncertainty
1.3 Calibration
1.4 Static and Dynamic Properties of Sensors and Systems
2 Measurement of Electrical Quantities
2.1 Current and Voltage
2.2 Impedance
2.3 Amplification
2.4 Oscilloscope
2.5 Analog-to-Digital Conversion
2.6 Data Transmission
3 Measurement of Nonelectric Quantities
3.1 Temperature
3.2 Length, Displacement, Angle
3.3 Strain, Force, Pressure
3.4 Flow
3.5 Time, Frequency
4 Chemical Analysis
4.1 Gas Sensors
4.2 Spectroscopy
4.3 Gas Chromatography

Literature:

Lerch, R.: „Elektrische Messtechnik; Analoge, digitale und computergestützte Verfahren“, Springer, 2006, ISBN: 978-3-540-34055-3.
Profos, P. Pfeifer, T.: „Handbuch der industriellen Messtechnik“, Oldenbourg, 2002, ISBN: 978-3486217940.

Module: Particle Technology and Solids Process Engineering

Courses:

Title	Typ	Hrs/wk
Particle Technology I	Vorlesung	2
Particle Technology I	Gruppenübung	1
Particle Technology I	Laborpraktikum	2

Module Responsibility:
Prof. Stefan Heinrich

Admission Requirements:
-

Recommended Previous Knowledge:

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
After successful completion of the module students are able to

- name and explain processes and unit-operations of solids process engineering,
- characterize particles, particle distributions and to discuss their bulk properties

Capabilities:
Students are able to

- choose and design apparatuses and processes for solids processing according to the desired solids properties of the product
- asses solids with respect to their behavior in solids processing steps

Personal Competence:
Social Competence:
Autonomy:

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 110, Study Time in Lecture: 70

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Chemical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (German program): Vertiefung Energy and Enviromental Engineering: Compulsory
Bioprocess Engineering: Kernqualifikation: Compulsory
Energy and Environmental Engineering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (English program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (English program): Vertiefung Chemical Engineering: Compulsory
Process Engineering: Kernqualifikation: Compulsory

Course: Particle Technology I (Vorlesung)

Lecturer:
Prof. Stefan Heinrich

Language:
DE

Cycle:
SS

Content:

- Description of particles and particle distributions
- Description of a separation process
- Description of a particle mixture
- Particle size reduction
- Agglomeration, particle size enlargement

- Storage and flow of bulk solids
- Basics of fluid/particle flows
- classifying processes
- Separation of particles from fluids
- Basic fluid mechanics of fluidized beds
- Pneumatic and hydraulic transport

Literature:

Schubert, H.; Heidenreich, E.; Liepe, F.; Neeße, T.: Mechanische Verfahrenstechnik. Deutscher Verlag für die Grundstoffindustrie, Leipzig, 1990.
Stieß, M.: Mechanische Verfahrenstechnik I und II. Springer Verlag, Berlin, 1992.

Course: Particle Technology I (Übung)

Lecturer:

Prof. Stefan Heinrich

Language:

DE

Cycle:

SS

Content:

- Description of particles and particle distributions
- Description of a separation process
- Description of a particle mixture
- Particle size reduction
- Agglomeration, particle size enlargement
- Storage and flow of bulk solids
- Basics of fluid/particle flows
- classifying processes
- Separation of particles from fluids
- Basic fluid mechanics of fluidized beds
- Pneumatic and hydraulic transport

Literature:

Schubert, H.; Heidenreich, E.; Liepe, F.; Neeße, T.: Mechanische Verfahrenstechnik. Deutscher Verlag für die Grundstoffindustrie, Leipzig, 1990.
Stieß, M.: Mechanische Verfahrenstechnik I und II. Springer Verlag, Berlin, 1992.

Course: Particle Technology I (Laborpraktikum)

Lecturer:

Prof. Stefan Heinrich

Language:

DE

Cycle:

SS

Content:

- Sieving
- Bulk properties
- Size reduction
- Mixing
- Gas cyclone
- Blaine-test, filtration
- Sedimentation

Literature:

Schubert, H.; Heidenreich, E.; Liepe, F.; Neeße, T.: Mechanische Verfahrenstechnik. Deutscher Verlag für die Grundstoffindustrie, Leipzig, 1990.
Stieß, M.: Mechanische Verfahrenstechnik I und II. Springer Verlag, Berlin, 1992.

Module: Discrete Algebraic Structures

Courses:

Title	Typ	Hrs/wk
Discrete Algebraic Structures	Vorlesung	2
Discrete Algebraic Structures	Gruppenübung	2

Module Responsibility:
Prof. Karl-Heinz Zimmermann

Admission Requirements:
None.

Recommended Previous Knowledge:
Mathematics from High School Diploma.

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students know the important basics of discrete algebraic structures including elementary combinatorial structures, groups, rings, and vector spaces. They also know specific structures like sub-. sum-, and quotient structures and homomorphisms.
Capabilities:
Students are able to formalize and analyze basic discrete algebraic structures.

Personal Competence:
Social Competence:
Students are able to solve specific problems alone or in a group and to present the results accordingly.
Autonomy:

Students are able to acquire new knowledge from specific standard books and to associate this knowledge with other classes.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Computer Science and Engineering: Compulsory
Computer Science: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Computer Science and Engineering: Compulsory
Computational Science and Engineering: Kernqualifikation: Compulsory
Technomathematics: Vertiefung Mathematics: Compulsory suffrage

Course: Discrete Algebraic Structures (Vorlesung)

Lecturer:
Prof. Karl-Heinz Zimmermann

Language:
DE

Cycle:
WS

Content:

Literature:

Course: Discrete Algebraic Structures (Übung)

Lecturer:
Prof. Karl-Heinz Zimmermann

Language:
DE

Cycle:
WS

Content:

Literature:

Module: Objectoriented Programming, Algorithms and Data Structures

Courses:

Title	Typ	Hrs/wk
Objectoriented Programming, Algorithms and Data Structures	Vorlesung	4
Objectoriented Programming, Algorithms and Data Structures	Gruppenübung	1

Module Responsibility:
Prof. Rolf-Rainer Grigat

Admission Requirements:
Lecture Prozedurale Programmierung or equivalent proficiency in imperative programming

Recommended Previous Knowledge:
Mandatory prerequisite for this lecture is proficiency in imperative programming (C, Pascal, Fortran or similar). You should be familiar with simple data types (integer, double, char), arrays, if-then-else, for, while, procedure calls or function calls, pointers, and you should have used all those in your own programs and therefore should be proficient with editor, compiler, linker and debugger. In this lecture we will immediately start with the introduction of objects and we will not repeat the basics mentioned above.
This remark is especially important for AIW, GES, LUM because those prerequisites are **not** part of the curriculum. They are prerequisites for the start of those curricula in general. The programs ET, CI and IIW include those prerequisites in the first semester in the lecture Prozedurale Programmierung.
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Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students can explain the essentials of software design and the design of a class architecture with reference to existing class libraries and design patterns.
Students can describe fundamental data structures of discrete mathematics and assess the complexity of important algorithms for sorting and searching.

Capabilities:
Students are able to

- Design software using given design patterns and applying class hierarchies and polymorphism
- Carry out software development and tests using version management systems and Google Test
- Sort and search for data efficiently
- Assess the complexity of algorithms.

Personal Competence:
Social Competence:
Students can work in teams and communicate in forums.

Autonomy:
Students are able to solve programming tasks such as LZW data compression using SVN Repository and Google Test independently and over a period of two to three weeks.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 110, Study Time in Lecture: 70

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Computer Science and Engineering: Compulsory
Computer Science: Kernqualifikation: Compulsory
Electrical Engineering: Kernqualifikation: Compulsory
Electrical Engineering myTrack: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Computer Science and Engineering: Compulsory
Computational Science and Engineering: Kernqualifikation: Compulsory
Logistics and Mobility: Vertiefung Engineering Science: Compulsory suffrage
Technomathematics: Kernqualifikation: Compulsory

Course: Objectoriented Programming, Algorithms and Data Structures (Vorlesung)

Lecturer:
Prof. Rolf-Rainer Grigat

Language:
DE

Cycle:
SS

Content:
Object oriented analysis and design:

- Objectoriented programming in C++ and Java
- generic programming
- UML
- design patterns

Data structures and algorithmes:

- complexity of algorithms
- searching, sorting, hash tables,
- stack, queues, lists,
- trees (AVL, heap, 2-3-4, Trie, Huffman, Patricia, B),
- sets, priority queues,
- directed and undirected graphs (spanning trees, shortest and longest path)

Literature:
Skriptum

Course: Objectoriented Programming, Algorithms and Data Structures (Übung)

Lecturer:
Prof. Rolf-Rainer Grigat

Language:
DE

Cycle:
SS

Content:
Object oriented analysis and design:

- Objectoriented programming in C++ and Java
- generic programming
- UML
- design patterns

Data structures and algorithmes:

- complexity of algorithms
- searching, sorting, hash tables,
- stack, queues, lists,
- trees (AVL, heap, 2-3-4, Trie, Huffman, Patricia, B),
- sets, priority queues,
- directed and undirected graphs (spanning trees, shortest and longest path)

Literature:
Skriptum

Module: Logic, Automata and Formal Languages

Courses:

Title	Typ	Hrs/wk
Logic, Automata Theory and Formal Languages	Vorlesung	2
Logic, Automata Theory and Formal Languages	Gruppenübung	2

Module Responsibility:
NN

Admission Requirements:

Recommended Previous Knowledge:
Participating students should be able to
- specify algorithms for simple data structures (such as, e.g., arrays) to solve computational problems
- apply propositional logic and predicate logic for specifying and understanding mathematical proofs
- apply the knowledge and skills taught in the module Discrete Algebraic Structures

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students can explain syntax, semantics, and decision problems of propositional logic, and they are able to give algorithms for solving decision problems. Students can show correspondences to Boolean algebra. Students can describe which application problems are hard to represent with propositional logic, and therefore, the students can motivate predicate logic, and define syntax, semantics, and decision problems for this representation formalism. Students can explain unification and resolution for solving the predicate logic SAT decision problem. Students can also describe syntax, semantics, and decision problems for various kinds of temporal logic, and identify their application areas. The participants of the course can define various kinds of finite automata and can identify relationships to logic and formal grammars. The spectrum that students can explain ranges from deterministic and nondeterministic finite automata and pushdown automata to Turing machines. Students can name those formalism for which nondeterminism is more expressive than determinism. They are also able to demonstrate which decision problems require which expressivity, and, in addition, students can transform decision problems w.r.t. one formalism into decision problems w.r.t. other formalisms. They understand that some formalisms easily induce algorithms whereas others are best suited for specifying systems and their properties. Students can describe the relationships between formalisms such as logic, automata, or grammars.

Capabilities:
Students can apply propositional logic as well as predicate logic resolution to a given set of formulas. Students analyze application problems in order to derive propositional logic, predicate logic, or temporal logic formulas to represent them. They can evaluate which formalism is best suited for a particular application problem, and they can demonstrate the application of algorithms for decision problems to specific formulas. Students can also transform nondeterministic automata into deterministic ones, or derive grammars from automata and vice versa. They can show how parsers work, and they can apply algorithms for the language emptiness problem in case of infinite words.

Personal Competence:
Social Competence:
Autonomy:

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Computer Science and Engineering: Compulsory
Computer Science: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Computer Science and Engineering: Compulsory
Computational Science and Engineering: Kernqualifikation: Compulsory
Technomathematics: Vertiefung Informatics: Compulsory suffrage

Course: Logic, Automata Theory and Formal Languages (Vorlesung)

Lecturer:
NN

Language:
EN

Cycle:
SS

Content:

1. Propositional logic, Boolean algebra, propositional resolution, SAT-2KNF
2. Predicate logic, unification, predicate logic resolution
3. Temporal Logics (LTL, CTL)
4. Deterministic finite automata, definition and construction
5. Regular languages, closure properties, word problem, string matching
6. Nondeterministic automata:
   Rabin-Scott transformation of nondeterministic into deterministic automata
7. Epsilon automata, minimization of automata,
   elimination of e-edges, uniqueness of the minimal automaton (modulo renaming of states)
8. Myhill-Nerode Theorem:
   Correctness of the minimization procedure, equivalence classes of strings induced by automata
9. Pumping Lemma for regular languages:
   provision of a tool which, in some cases, can be used to show that a finite automaton principally cannot be expressive enough to solve a word problem for some given language
10. Regular expressions vs. finite automata:
    Equivalence of formalisms, systematic transformation of representations, reductions
11. Pushdown automata and context-free grammars:
    Definition of pushdown automata, definition of context-free grammars, derivations, parse trees, ambiguities, pumping lemma for context-free grammars, transformation of formalisms (from pushdown automata to context-free grammars and back)
12. Chomsky normal form
13. CYK algorithm for deciding the word problem for context-free grammrs
14. Deterministic pushdown automata
15. Deterministic vs. nondeterministic pushdown automata:
    Application for parsing, LL(k) or LR(k) grammars and parsers vs. deterministic pushdown automata, compiler compiler
16. Regular grammars
17. Outlook: Turing machines and linear bounded automata vs general and context-sensitive grammars
18. Chomsky hierarchy
19. Mealy- and Moore automata:
    Automata with output (w/o accepting states), infinite state sequences, automata networks
20. Omega automata: Automata for infinite input words, Büchi automata, representation of state transition systems, verification w.r.t. temporal logic specifications (in particular LTL)
21. LTL safety conditions and model checking with Büchi automata, relationships between automata and logic
22. Fixed points, propositional mu-calculus
23. Characterization of regular languages by monadic second-order logic (MSO)

Literature:

1. Logik für Informatiker Uwe Schöning, Spektrum, 5. Aufl.
2. Logik für Informatiker Martin Kreuzer, Stefan Kühling, Pearson Studium, 2006
3. Grundkurs Theoretische Informatik, Gottfried Vossen, Kurt-Ulrich Witt, Vieweg-Verlag, 2010.
4. Principles of Model Checking, Christel Baier, Joost-Pieter Katoen, The MIT Press, 2007

Course: Logic, Automata Theory and Formal Languages (Übung)

Lecturer:
NN

Language:
EN

Cycle:
SS

Content:

1. Propositional logic, Boolean algebra, propositional resolution, SAT-2KNF
2. Predicate logic, unification, predicate logic resolution
3. Temporal Logics (LTL, CTL)
4. Deterministic finite automata, definition and construction
5. Regular languages, closure properties, word problem, string matching
6. Nondeterministic automata:
   Rabin-Scott transformation of nondeterministic into deterministic automata
7. Epsilon automata, minimization of automata,
   elimination of e-edges, uniqueness of the minimal automaton (modulo renaming of states)
8. Myhill-Nerode Theorem:
   Correctness of the minimization procedure, equivalence classes of strings induced by automata
9. Pumping Lemma for regular languages:
   provision of a tool which, in some cases, can be used to show that a finite automaton principally cannot be expressive enough to solve a word problem for some given language
10. Regular expressions vs. finite automata:

Equivalence of formalisms, systematic transformation of representations, reductions

11. Pushdown automata and context-free grammars:
    Definition of pushdown automata, definition of context-free grammars, derivations, parse trees, ambiguities, pumping lemma for context-free grammars, transformation of formalisms (from pushdown automata to context-free grammars and back)
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15. Deterministic vs. nondeterministic pushdown automata:
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16. Regular grammars
17. Outlook: Turing machines and linear bounded automata vs general and context-sensitive grammars
18. Chomsky hierarchy
19. Mealy- and Moore automata:
    Automata with output (w/o accepting states), infinite state sequences, automata networks
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4. Principles of Model Checking, Christel Baier, Joost-Pieter Katoen, The MIT Press, 2007

Module: Signals and Systems

Courses:

Title	Typ	Hrs/wk
Signals and Systems	Vorlesung	3
Signals and Systems	Hörsaalübung	1

Module Responsibility:
Prof. Gerhard Bauch

Admission Requirements:
Mathematics 1-3

Recommended Previous Knowledge:

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students are able to classify and describe signals and linear time-invariant (LTI) systems using methods of signal and system theory. They are able to apply the fundamental transformations of continuous-time and discrete-time signals and systems. They can describe and analyse deterministic signals and systems mathematically in both time and image domain. In particular, they understand the effects in time domain and image domain which are caused by the transition of a continuous-time signal to a discrete-time signal.
Capabilities:
The students are able to describe and analyse deterministic signals and linear time-invariant systems using methods of signal and system theory. They can analyse and design basic systems regarding important properties such as magnitude and phase response, stability, linearity etc.. They can assess the impact of LTI systems on the signal properties in time and frequency domain.

Personal Competence:
Social Competence:
The students can jointly solve specific problems.
Autonomy:
The students are able to acquire relevant information from appropriate literature sources. They can control their level of knowledge during the lecture period by solving tutorial problems, software tools, clicker system.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Electrical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Computer Science and Engineering: Compulsory
General Engineering Science (German program): Vertiefung Chemical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (German program): Vertiefung Civil- and Enviromental Engeneering: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Biomedical Engineering: Compulsory
Computer Science: Kernqualifikation: Compulsory
Electrical Engineering: Kernqualifikation: Compulsory
Electrical Engineering myTrack: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Civil- and Enviromental Engeneering: Compulsory
General Engineering Science (English program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (English program): Vertiefung Electrical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Computer Science and Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Chemical Engineering: Compulsory
Computational Science and Engineering: Kernqualifikation: Compulsory
Mechatronics: Kernqualifikation: Compulsory
Technomathematics: Vertiefung Engineering Science: Compulsory suffrage

Course: Signals and Systems (Vorlesung)

Lecturer:
Prof. Gerhard Bauch

Language:
DE/EN

Cycle:
SS

Content:

- Basic classification and description of continuous-time and discrete-time signals and systems
- Concvolution
- Power and energy of signals
- Correlation functions of deterministic signals
- Linear time-invariant (LTI) systems
- Signal transformations:
  - Fourier-Series
  - Fourier Transform
  - Laplace Transform
  - Discrete-time Fourier Transform
  - Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT)
  - Z-Transform
- Analysis and design of LTI systems in time and frequency domain
- Basic filter types
- Sampling, sampling theorem
- Fundamentals of recursive and non-recursive discrete-time filters

Literature:

- T. Frey , M. Bossert , Signal- und Systemtheorie, B.G. Teubner Verlag 2004
- K. Kammeyer, K. Kroschel, Digitale Signalverarbeitung, Teubner Verlag.
- B. Girod ,R. Rabensteiner , A. Stenger , Einführung in die Systemtheorie, B.G. Teubner, Stuttgart, 1997
- J.R. Ohm, H.D. Lüke , Signalübertragung, Springer-Verlag 8. Auflage, 2002
- S. Haykin, B. van Veen: Signals and systems. Wiley.
- Oppenheim, A.S. Willsky: Signals and Systems. Pearson.
- Oppenheim, R. W. Schafer: Discrete-time signal processing. Pearson.

Course: Signals and Systems (Übung)

Lecturer:
Prof. Gerhard Bauch

Language:
DE/EN

Cycle:
SS

Content:

- Basic classification and description of continuous-time and discrete-time signals and systems
- Concvolution
- Power and energy of signals
- Correlation functions of deterministic signals
- Linear time-invariant (LTI) systems
- Signal transformations:
  - Fourier-Series
  - Fourier Transform
  - Laplace Transform
  - Discrete-time Fourier Transform
  - Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT)
  - Z-Transform
- Analysis and design of LTI systems in time and frequency domain
- Basic filter types
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- B. Girod ,R. Rabensteiner , A. Stenger , Einführung in die Systemtheorie, B.G. Teubner, Stuttgart, 1997
- J.R. Ohm, H.D. Lüke , Signalübertragung, Springer-Verlag 8. Auflage, 2002
- S. Haykin, B. van Veen: Signals and systems. Wiley.
- Oppenheim, A.S. Willsky: Signals and Systems. Pearson.
- Oppenheim, R. W. Schafer: Discrete-time signal processing. Pearson.

Courses:

Title	Typ	Hrs/wk
Introduction to Management	Vorlesung	4
Project Entrepreneurship	Problemorientierte Lehrveranstaltung	2

Module Responsibility:
Prof. Kathrin Fischer

Admission Requirements:
None

Recommended Previous Knowledge:
Basic Knowledge of Mathematics and Business

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
After taking this module, students know the important basics of many different areas in Business and Management, from Planning and Organisation to Marketing and Innovation, and also to Investment and Controlling. In particular they are able to

- explain the differences between Economics and Management and the sub-disciplines in Management and to name important definitions from the field of Management
- explain the most important aspects of and goals in Management and name the most important aspects of entreprneurial projects
- describe and explain basic business functions as production, procurement and sourcing, supply chain management, organization and human ressource management, information management, innovation management and marketing
- explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives and uncertainty, and explain some basic methods from mathematical Finance
- state basics from accounting and costing and selected controlling methods.

Capabilities:
Students are able to analyse business units with respect to different criteria (organization, objectives, strategies etc.) and to carry out an Entrepreneurship project in a team. In particular, they are able to

- analyse Management goals and structure them appropriately
- analyse organisational and staff structures of companies
- apply methods for decision making under multiple objectives, under uncertainty and under risk
- analyse production and procurement systems and Business information systems
- analyse and apply basic methods of marketing
- select and apply basic methods from mathematical finance to predefined problems
- apply basic methods from accounting, costing and controlling to predefined problems

Personal Competence:
Social Competence:
Students are able to

- work successfully in a team of students
- to apply their knowledge from the lecture to an entrepreneurship project and write a coherent report on the project
- to communicate appropriately and
- to cooperate respectfully with their fellow students.

Autonomy:
Students are able to

- work in a team and to organize the team themselves
- to write a report on their project.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 96, Study Time in Lecture: 84

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Electrical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Computer Science and Engineering: Compulsory
General Engineering Science (German program): Vertiefung Chemical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Bioprocess Engineering: Compulsory

General Engineering Science (German program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (German program): Vertiefung Civil- and Enviromental Engeneering: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Naval Architecture: Compulsory
Civil- and Environmental Engeneering: Kernqualifikation: Compulsory
Bioprocess Engineering: Kernqualifikation: Compulsory
Computer Science: Kernqualifikation: Compulsory
Electrical Engineering: Kernqualifikation: Compulsory
Electrical Engineering myTrack: Kernqualifikation: Compulsory
Energy and Environmental Engineering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Civil- and Enviromental Engeneering: Compulsory
General Engineering Science (English program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (English program): Vertiefung Electrical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (English program): Vertiefung Computer Science and Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Naval Architecture: Compulsory
General Engineering Science (English program): Vertiefung Chemical Engineering: Compulsory
Computational Science and Engineering: Kernqualifikation: Compulsory
Logistics and Mobility: Kernqualifikation: Compulsory
Mechanical Engineering: Kernqualifikation: Compulsory
Mechatronics: Kernqualifikation: Compulsory
Naval Architecture: Kernqualifikation: Compulsory
Technomathematics: Kernqualifikation: Compulsory
Process Engineering: Kernqualifikation: Compulsory

Course: Introduction to Management (Vorlesung)

Lecturer:
Prof. Kathrin Fischer, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Cornelius Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona

Language:
DE

Cycle:
WS/SS

Content:

- Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management
- Important definitions from Management,
- Developing Objectives for Business, and their relation to important Business functions
- Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supply Chain Management, Innovation Management, Marketing and Sales
  Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management
- Definitions as information, information systems, aspects of data security and strategic information systems
- Definition and Relevance of innovations, e.g. innovation opporunities, risks etc.
- Relevance of marketing, B2B vs. B2C-Marketing
- different techniques from the field of marketing (e.g. scenario technique), pricing strategies
- important organizational structures
- basics of human ressource management
- Introduction to Business Planning and the steps of a planning process
- Decision Analysis: Elements of decision problems and methods for solving decision problems
- Selected Planning Tasks, e.g. Investment and Financial Decisions
- Introduction to Accounting: Accounting, Balance-Sheets, Costing
- Relevance of Controlling and selected Controlling methods
- Important aspects of Entrepreneurship projects

Literature:
Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008
Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003
Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006.
Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001.
Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgart 2008.
Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeine Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005.
Weber, J., Schäffer, U. : Einführung in das Controlling, 12. Auflage, Stuttgart 2008.
Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006.

Course: Project Entrepreneurship (Problemorientierte Lehrveranstaltung)

Lecturer:
Prof. Christoph Ihl

Language:
DE

Cycle:
WS/SS

Content:
In this project module, students work on an Entrepreneurship project. They are required to go through all relevant steps, from the first idea to the concept, using their knowledge from the corresponding lecture.
Project work is carried out in teams with the support of a mentor.

Literature:
Relevante Literatur aus der korrespondierenden Vorlesung.

Module: Graph Theory and Optimization

Courses:

Title	Typ	Hrs/wk
Graph Theory and Optimization	Vorlesung	2
Graph Theory and Optimization	Gruppenübung	2

Module Responsibility:
Prof. Anusch Taraz

Admission Requirements:
none

Recommended Previous Knowledge:

- Discrete Algebraic Structures
- Mathematics I

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:

- Students can name the basic concepts in Graph Theory and Optimization. They are able to explain them using appropriate examples.
- Students can discuss logical connections between these concepts. They are capable of illustrating these connections with the help of examples.
- They know proof strategies and can reproduce them.

Capabilities:

- Students can model problems in Graph Theory and Optimization with the help of the concepts studied in this course. Moreover, they are capable of solving them by applying established methods.
- Students are able to discover and verify further logical connections between the concepts studied in the course.
- For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results.

Personal Competence:
Social Competence:

- Students are able to work together in teams. They are capable to use mathematics as a common language.
- In doing so, they can communicate new concepts according to the needs of their cooperating partners. Moreover, they can design examples to check and deepen the understanding of their peers.

Autonomy:

- Students are capable of checking their understanding of complex concepts on their own. They can specify open questions precisely and know where to get help in solving them.
- Students have developed sufficient persistence to be able to work for longer periods in a goal-oriented manner on hard problems.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Computer Science and Engineering: Compulsory
Computer Science: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Computer Science and Engineering: Compulsory
Computational Science and Engineering: Kernqualifikation: Compulsory
Logistics and Mobility: Vertiefung Engineering Science: Compulsory suffrage
Technomathematics: Vertiefung Mathematics: Compulsory suffrage

Course: Graph Theory and Optimization (Vorlesung)

Lecturer:
Prof. Anusch Taraz

Language:
DE

Cycle:
SS

Content:

- Graphs, search algorithms for graphs, trees
- planar graphs
- shortest paths
- minimum spanning trees
- maximum flow and minimum cut
- theorems of Menger, König-Egervary, Hall
- NP-complete problems
- backtracking and heuristics
- linear programming
- duality
- integer linear programming

Literature:

- M. Aigner: Diskrete Mathematik, Vieweg, 2004
- J. Matousek und J. Nesetril: Diskrete Mathematik, Springer, 2007
- A. Steger: Diskrete Strukturen (Band 1), Springer, 2001
- A. Taraz: Diskrete Mathematik, Birkhäuser, 2012
- V. Turau: Algorithmische Graphentheorie, Oldenbourg, 2009
- K.-H. Zimmermann: Diskrete Mathematik, BoD, 2006

Course: Graph Theory and Optimization (Übung)

Lecturer:
Prof. Anusch Taraz

Language:
DE

Cycle:
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- Graphs, search algorithms for graphs, trees
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Courses:

Title	Typ	Hrs/wk
Conceptual Modeling, Databases, and Data Management	Vorlesung	4
Conceptual Modeling, Databases, and Data Management	Problemorientierte Lehrveranstaltung	1

Module Responsibility:
NN

Admission Requirements:

Recommended Previous Knowledge:
Students should habe basic knowledge in the following areas:

- Discrete Algebraic Structures
- Procedural Programming
- Logic, Automata, and Formal Languages
- Object-Oriented Programming, Algorithms and Data Structures

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students can explain the general architecture of an application system that is based on a database. They describe the syntax and semantics of the Entity Relationship conceptual modeling languages, and they can enumerate basic decision problems and know which features of a domain model can be captured with ER and which features cannot be represented. Furthermore, students can summarize the features of the relational data model, and can describe how ER models can be systematically transformed into the relational data model. Student are able to discuss dependency theory using the operators of relational algebra, and they know how to use relational algebra as a query language. In addition, they can sketch the main modules of the architecture of a database system from an implementation point of view. Storage and index structures as well as query answering and optimization techniques can be explained. The role of transactions can be described in terms of ACID conditions and common recovery mechanisms can be characterized. The students can recall why recursion is important for query languages and describe how Datalog can be used and implemented.They demonstrate how Datalog can be used for information integration. For solving ER decision problems the students can explain description logics with their syntax and semantics, they describe description logic decision problems and explain how these problems can be mapped onto each other. They can sketch the idea of ontology-based data access and can name the main complexity measure in database theory. Last but not least, the students can describe the main features of XML and can explain XPath and XQuery as query languages.
Capabilities:
Students can apply ER for describing domains for which they receive a textual description, and students can transform relational schemata with a given set of functional dependencies into third normal form or even Boyce-Codd normal form. They can also apply relational algebra, SQL, or Datalog to specify queries. Using specific datasets, they can explain how index structures work (e.g., B-trees) and how index structures change while data is added or deleted. They can rewrite queries for better performance of query evaluation. Students can analyse which query language expressivity is required for which application problem. Description logics can be applied for domain modeling, and students can transform ER diagrams into description logics in order to check for consistency and implicit subsumption relations. They solve data integration problems using Datalog and LAV or GAV rules. Students can apply XPath and Xquery to retrieve certain patterns in XML data.

Personal Competence:
Social Competence:
Students develop an understanding of social structures in a company used for developing real-world products. They know the responsibilities of data analysts, programmers, and managers in the overall production process.
Autonomy:

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 110, Study Time in Lecture: 70

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Computer Science and Engineering: Compulsory
Computer Science: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Computer Science and Engineering: Compulsory
Computational Science and Engineering: Vertiefung Computer Science: Compulsory suffrage
Technomathematics: Kernqualifikation: Compulsory suffrage

Course: Conceptual Modeling, Databases, and Data Management (Vorlesung)

Lecturer:
NN

Language:
EN

Cycle:
WS

Content:

- Architecture of database systems, conceptual data modeling with the Entity Relationship (ER) modeling language
- Relational data model, referential integrity, keys, foreign keys, functional dependencies (FDs), canonical mapping of entity types and relationship into the relational data model, anomalies
- Relational algebra as a simple query language
- Dependency theory, FD closure, canonical cover of FD set, decomposition of relational schemata, multivalued dependencies, normalization, inclusion dependencies
- Practical query languages and integrity constraints w/o considering a conceptual domain model: SQL
- Storage structures, database implementation architecture
- Index structures
- Query processing
- Query optimization
- Transactions and recovery
- Query languages with recursion and consideration of a simple conceptual domain model: Datalog
- Semi-naive evaluation strategy, magic sets transformation
- Information integration, declarative schema transformation (LAV, GAV), distributed database systems
- Description logics, syntax, semantics, decision problems, decision algorithms for Abox satisfiability
- Ontology based data access (OBDA), DL-Lite for formalizing ER diagramms
- Complexity measure: Data complexity
- Semistructured databases and query languages: XML and XQuery

Literature:

1. A. Kemper, A. Eickler, Datenbanksysteme - n. Auflage, Oldenbourg, 2010
2. S. Abiteboul, R. Hull, V. Vianu, Foundations of Databases, Addison-Wesley, 1995
3. Database Systems, An Application Oriented Approach, Pearson International Edition, 2005
4. H. Garcia-Molina, J.D. Ullman, J. Widom, Database Systems: The Complete Book, Prentice Hall, 2002

Course: Conceptual Modeling, Databases, and Data Management (Problemorientierte Lehrveranstaltung)

Lecturer:
NN

Language:
EN

Cycle:
WS

Content:

- Architecture of database systems, conceptual data modeling with the Entity Relationship (ER) modeling language
- Relational data model, referential integrity, keys, foreign keys, functional dependencies (FDs), canonical mapping of entity types and relationship into the relational data model, anomalies
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- Query optimization
- Transactions and recovery
- Query languages with recursion and consideration of a simple conceptual domain model: Datalog
- Semi-naive evaluation strategy, magic sets transformation
- Information integration, declarative schema transformation (LAV, GAV), distributed database systems
- Description logics, syntax, semantics, decision problems, decision algorithms for Abox satisfiability
- Ontology based data access (OBDA), DL-Lite for formalizing ER diagramms
- Complexity measure: Data complexity
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Courses:

Title	Typ	Hrs/wk
Numerical Mathematics I	Vorlesung	2
Numerical Mathematics I	Gruppenübung	2

Module Responsibility:
Prof. Sabine Le Borne

Admission Requirements:

- Mathematik I + II for Engineering Students (german or english)

or

- Analysis & Linear Algebra I + II for Technomathematicians

Recommended Previous Knowledge:

- Lecture material of prerequisite lectures
- basic MATLAB knowledge

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students are able to

- name numerical methods for interpolation, integration, least squares problems, eigenvalue problems, nonlinear root finding problems and to explain their core ideas,
- repeat convergence statements for the numerical methods,
- explain aspects for the practical execution of numerical methods with respect to computational and storage complexitx.

Capabilities:
Students are able to

- implement, apply and compare numerical methods using MATLAB,
- justify the convergence behaviour of numerical methods with respect to the problem and solution algorithm,
- select and execute a suitable solution approach for a given problem.

Personal Competence:
Social Competence:
Students are able to

- work together in heterogeneously composed teams (i.e., teams from different study programs and background knowledge), explain theoretical foundations and support each other with practical aspects regarding the implementation of algorithms.

Autonomy:
Students are capable

- to assess whether the supporting theoretical and practical excercises are better solved individually or in a team,
- to assess their individual progess and, if necessary, to ask questions and seek help.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Computer Science and Engineering: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Biomechanics: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Materials in Engineering Sciences: Compulsory
General Engineering Science (German program): Vertiefung Biomedical Engineering: Compulsory
Bioprocess Engineering: Vertiefung A - General Bioprocess Engineering: Compulsory suffrage
Computer Science: Vertiefung Computational Mathematics: Compulsory suffrage
Electrical Engineering: Kernqualifikation: Compulsory suffrage
Electrical Engineering myTrack: Kernqualifikation: Compulsory suffrage

General Engineering Science (English program): Vertiefung Computer Science and Engineering: Compulsory
General Engineering Science (English program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Biomechanics: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Materials in Engineering Sciences: Compulsory
Computational Science and Engineering: Kernqualifikation: Compulsory
Process Engineering: Vertiefung Process Engineering : Compulsory suffrage

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Course: Numerical Mathematics I (Vorlesung)

Lecturer:
Prof. Sabine Le Borne

Language:
DE

Cycle:
WS

Content:

1. Error analysis: Number representation, error types, conditioning and stability
2. Interpolation: polynomial and spline interpolation
3. Numerical integration and differentiation: order, Newton-Cotes formula, error estimates, Gaussian quadrature, adaptive quadrature, difference formulas
4. Linear systems: LU and Cholesky factorization, matrix norms, conditioning
5. Linear least squares problems: normal equations, Gram.Schmidt and Householder orthogonalization, singular value decomposition, regularization
6. Eigenvalue problems: power iteration, inverse iteration, QR algorithm
7. Nonlinear systems of equations: Fixed point iteration, root-finding algorithms for real-valued functions, Newton and Quasi-Newton methods for systems

Literature:

- Stoer/Bulirsch: Numerische Mathematik 1, Springer
- Dahmen, Reusken: Numerik für Ingenieure und Naturwissenschaftler, Springer

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Course: Numerical Mathematics I (Übung)

Lecturer:
Prof. Sabine Le Borne

Language:
DE

Cycle:
WS

Content:

1. Error analysis: Number representation, error types, conditioning and stability
2. Interpolation: polynomial and spline interpolation
3. Numerical integration and differentiation: order, Newton-Cotes formula, error estimates, Gaussian quadrature, adaptive quadrature, difference formulas
4. Linear systems: LU and Cholesky factorization, matrix norms, conditioning
5. Linear least squares problems: normal equations, Gram.Schmidt and Householder orthogonalization, singular value decomposition, regularization
6. Eigenvalue problems: power iteration, inverse iteration, QR algorithm
7. Nonlinear systems of equations: Fixed point iteration, root-finding algorithms for real-valued functions, Newton and Quasi-Newton methods for systems

Literature:

- Stoer/Bulirsch: Numerische Mathematik 1, Springer
- Dahmen, Reusken: Numerik für Ingenieure und Naturwissenschaftler, Springer

Module: Computer Architecture

Courses:

Title	Typ	Hrs/wk
Computer Architekture	Vorlesung	2
Computer Architekture	Gruppenübung	2

Module Responsibility:
NN

Admission Requirements:
None.

Recommended Previous Knowledge:
Computer Engineering

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students know the basic principles of computer design and evaluation. In particular, the design of instruction sets, memory, processors, instruction pipelining, and multiprocessor systems.
Capabilities:
Students are able to describe computer architectures and evaluate and compare them.

Personal Competence:
Social Competence:
Students are able to solve specific problems alone or in a group and to present the results accordingly.
Autonomy:
Students are able to acquire new knowledge from newer literature and to associate this knowledge with other classes.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Computer Science and Engineering: Compulsory
Computer Science: Vertiefung Computer Engineering: Compulsory suffrage
General Engineering Science (English program): Vertiefung Computer Science and Engineering: Compulsory
Computational Science and Engineering: Kernqualifikation: Compulsory suffrage

Course: Computer Architekture (Vorlesung)

Lecturer:
NN

Language:
DE/EN

Cycle:
WS

Content:

Literature:

Course: Computer Architekture (Übung)

Lecturer:
NN

Language:
DE/EN

Cycle:
WS

Content:

Literature:

Module: Seminars Computer Science and Mathematics

Courses:

Title	Typ	Hrs/wk
Proseminar Computational Mathematics	Seminar	2
Proseminar Computer Science	Seminar	2
Seminar	Seminar	2

Module Responsibility:
Dozenten des SD E

Admission Requirements:

Recommended Previous Knowledge:
Basic knowledge in Computer Science

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Capabilities:

Personal Competence:
Social Competence:
Autonomy:

ECTS-Credit points:
6 LP

Examination:
Referat

Workload in Hours:
Indipendent Study Time: 96, Study Time in Lecture: 84

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Computer Science and Engineering: Compulsory
Computer Science: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Computer Science and Engineering: Compulsory
Computational Science and Engineering: Kernqualifikation: Compulsory

Course: Proseminar Computational Mathematics (Seminar)

Lecturer:
Dozenten des SD E

Language:
DE/EN

Cycle:
WS

Content:

- Seminar presentations by enrolled students. Seminar topics from the field of computer-oriented mathematics are proposed by the organizer
- Active participation in discussions.

Literature:
Wird vom Seminarveranstalter bekanntgegeben.

Course: Proseminar Computer Science (Seminar)

Lecturer:
Dozenten des SD E

Language:
DE/EN

Cycle:
WS

Content:

- Seminar presentations by enrolled students. Seminar topics from the field of computer science are proposed by the organizer
- Active participation in discussions.

Literature:
Wird vom Seminarveranstalter bekanntgegeben.

Course: Seminar (Seminar)

Lecturer:
Dozenten des SD E

Language:
DE/EN

Cycle:
WS

Content:

- Seminar presentations by enrolled students. Seminar topics from the field of computer-oriented mathematics or computer science are proposed by the organizer
- Active participation in discussions.

Literature:
Wird vom Seminarveranstalter bekanntgegeben.

Module: Computernetworks and Internet Security

Courses:

Title	Typ	Hrs/wk
Computer Networks and Internet Security	Vorlesung	3
Computer Networks and Internet Security	Gruppenübung	1

Module Responsibility:
Prof. Andreas Timm-Giel

Admission Requirements:

Recommended Previous Knowledge:

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students are able to explain important and common Internet protocols in detail and classify them, in order to be able to analyse and develop networked systems in further studies and job.
Capabilities:
Students are able to analyse common Internet protocols and evaluate the use of them in different domains.

Personal Competence:
Social Competence:

Autonomy:
Students can select relevant parts out of high amount of professional knowledge and can independently learn and understand it.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Computer Science and Engineering: Compulsory
Computer Science: Kernqualifikation: Compulsory
Electrical Engineering: Kernqualifikation: Compulsory suffrage
Electrical Engineering myTrack: Kernqualifikation: Compulsory suffrage
General Engineering Science (English program): Vertiefung Computer Science and Engineering: Compulsory
Computational Science and Engineering: Kernqualifikation: Compulsory
Technomathematics: Vertiefung Informatics: Compulsory suffrage

Course: Computer Networks and Internet Security (Vorlesung)

Lecturer:
Prof. Andreas Timm-Giel, Prof. Dieter Gollmann

Language:
EN

Cycle:
WS

Content:
In this class an introduction to computer networks with focus on the Internet and its security is given. Basic functionality of complex protocols are introduced. Students learn to understand these and identify common principles. In the exercises these basic principles and an introduction to performance modelling are addressed using computing tasks and (virtual) labs.
In the second part of the lecture an introduction to Internet security is given.
This class comprises:

- Application layer protocols (HTTP, FTP, DNS)
- Transport layer protocols (TCP, UDP)
- Network Layer (Internet Protocol, routing in the Internet)
- Data link layer with media access at the example of Ethernet
- Multimedia applications in the Internet
- Network management
- Internet security: IPSec
- Internet security: Firewalls

Literature:

- Kurose, Ross, Computer Networking - A Top-Down Approach, 6th Edition, Addison-Wesley
- Kurose, Ross, Computernetzwerke - Der Top-Down-Ansatz, Pearson Studium; Auflage: 6. Auflage
- W. Stallings: Cryptography and Network Security: Principles and Practice, 6th edition

Further literature is announced at the beginning of the lecture.

Course: Computer Networks and Internet Security (Übung)

Lecturer:
Prof. Andreas Timm-Giel, Prof. Dieter Gollmann

Language:
EN

Cycle:
WS

Content:
In this class an introduction to computer networks with focus on the Internet and its security is given. Basic functionality of complex protocols are introduced. Students learn to understand these and identify common principles. In the exercises these basic principles and an introduction to performance modelling are addressed using computing tasks and (virtual) labs.
In the second part of the lecture an introduction to Internet security is given.
This class comprises:

- Application layer protocols (HTTP, FTP, DNS)
- Transport layer protocols (TCP, UDP)
- Network Layer (Internet Protocol, routing in the Internet)
- Data link layer with media access at the example of Ethernet
- Multimedia applications in the Internet
- Network management
- Internet security: IPSec
- Internet security: Firewalls

Literature:

- Kurose, Ross, Computer Networking - A Top-Down Approach, 6th Edition, Addison-Wesley
- Kurose, Ross, Computernetzwerke - Der Top-Down-Ansatz, Pearson Studium; Auflage: 6. Auflage
- W. Stallings: Cryptography and Network Security: Principles and Practice, 6th edition

Further literature is announced at the beginning of the lecture.

Module: Stochastics

Courses:

Title	Typ	Hrs/wk
Stochastics	Vorlesung	2
Stochastics	Gruppenübung	2

Module Responsibility:
NN

Admission Requirements:

Recommended Previous Knowledge:

- Calculus
- Discrete algebraic structures (combinatorics)
- Propositional logic

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students can explain the main definitions of probability, and they can give basic definitions of modeling elements (random variables, events, dependence, independence assumptions) used in discrete and continuous settings (joint and marginal distributions, density functions). Students can describe characteristic notions such as expected values, variance, standard deviation, and moments. Students can define decision problems and explain algorithms for solving these problems (based on the chain rule or Bayesian networks). Algorithms, or estimators as they are caller, can be analyzed in terms of notions such as bias of an estimator, etc. Student can describe the main ideas of stochastic processes and explain algorithms for solving decision and computation problem for stochastic processes. Students can also explain basic statistical detection and estimation techniques.
Capabilities:
Students can apply algorithms for solving decision problems, and they can justify whether approximation techniques are good enough in various application contexts, i.e., students can derive estimators and judge whether they are applicable or reliable.

Personal Competence:
Social Competence:
Autonomy:

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Computer Science and Engineering: Compulsory
Computer Science: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Computer Science and Engineering: Compulsory
Computational Science and Engineering: Kernqualifikation: Compulsory
Logistics and Mobility: Vertiefung Engineering Science: Compulsory suffrage

Course: Stochastics (Vorlesung)

Lecturer:
NN

Language:
EN

Cycle:
SS

Content:
Foundations of probability theory

- Definitions of probability, conditional probability
- Random variables, dependencies, independence assumptions,
- Marginal and joint probabilities
- Distributions and density functions
- Characteristics: expected values, variance, standard deviation, moments

Practical representations for joint probabilities

- Bayessche Netzwerke
- Semantik, Entscheidungsprobleme, exakte und approximative Algorithmen

Stochastic processes

- Stationarity, ergodicity
- Correlations
- Dynamic Bayesian networks, Hidden Markov networks, Kalman filters, queues

Detection & estimation

- Detectors
- Estimation rules and procedures
- Hypothesis and distribution tests
- Stochastic regression

Literature:

1. Methoden der statistischen Inferenz, Likelihood und Bayes, Held, L., Spektrum 2008
2. Stochastik für Informatiker, Dümbgen, L., Springer 2003
3. Statistik: Der Weg zur Datenanalyse, Fahrmeir, L., Künstler R., Pigeot, I, Tutz, G., Springer 2010
4. Stochastik, Georgii, H.-O., deGruyter, 2009
5. Probability and Random Processes, Grimmett, G., Stirzaker, D., Oxford University Press, 2001
6. Programmieren mit R, Ligges, U., Springer 2008

Course: Stochastics (Übung)

Lecturer:
NN

Language:
EN

Cycle:
SS

Content:
Foundations of probability theory

- Definitions of probability, conditional probability
- Random variables, dependencies, independence assumptions,
- Marginal and joint probabilities
- Distributions and density functions
- Characteristics: expected values, variance, standard deviation, moments

Practical representations for joint probabilities

- Bayessche Netzwerke
- Semantik, Entscheidungsprobleme, exakte und approximative Algorithmen

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- Stationarity, ergodicity
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Literature:

1. Methoden der statistischen Inferenz, Likelihood und Bayes, Held, L., Spektrum 2008
2. Stochastik für Informatiker, Dümbgen, L., Springer 2003
3. Statistik: Der Weg zur Datenanalyse, Fahrmeir, L., Künstler R., Pigeot, I, Tutz, G., Springer 2010
4. Stochastik, Georgii, H.-O., deGruyter, 2009
5. Probability and Random Processes, Grimmett, G., Stirzaker, D., Oxford University Press, 2001
6. Programmieren mit R, Ligges, U., Springer 2008

Module: Operating Systems

Courses:

Title	Typ	Hrs/wk
Operating Systems	Vorlesung	2
Operating Systems	Gruppenübung	2

Module Responsibility:
Prof. Volker Turau

Admission Requirements:

- Procedural programming
- Object-oriented programming, algorithms, and data structures

Recommended Previous Knowledge:

- Experience in using tools related to operating systems such as editors, linkers, compilers
- Experience in using C-libraries

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students explain the main abstractions process, virtual memory, deadlock, lifelock, and file of operations systems, describe the process states and their transitions, and paraphrase the architectural variants of operating systems. They give examples of existing operating systems and explain their architectures. The participants of the course write concurrent programs using threads, conditional variables and semaphores. Students can describe the variants of realizing a file system. Students explain at least three different scheduling algorithms.
Capabilities:
Students are able to use the POSIX libraries for concurrent programming in a correct and efficient way. They are able to judge the efficiency of a scheduling algorithm for a given scheduling task in a given environment.

Personal Competence:
Social Competence:
Autonomy:

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Computer Science and Engineering: Compulsory
Computer Science: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Computer Science and Engineering: Compulsory
Computational Science and Engineering: Vertiefung Computer Science: Compulsory suffrage
Technomathematics: Vertiefung Informatics: Compulsory suffrage

Course: Operating Systems (Vorlesung)

Lecturer:
Prof. Volker Turau

Language:
DE

Cycle:
SS

Content:

- Architectures for Operating Systems
- Processes
- Concurrency
- Deadlocks
- Memory organization
- Scheduling
- File systems

Literature:

1. Operating Systems, William Stallings, Pearson International Edition
2. Moderne Betriebssysteme, Andrew Tanenbaum, Pearson Studium

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Course: Operating Systems (Übung)

Lecturer:
Prof. Volker Turau

Language:
DE

Cycle:
SS

Content:

- Architectures for Operating Systems
- Processes
- Concurrency
- Deadlocks
- Memory organization
- Scheduling
- File systems

Literature:

1. Operating Systems, William Stallings, Pearson International Edition
2. Moderne Betriebssysteme, Andrew Tanenbaum, Pearson Studium

Specialisation Mechanical Engineering

The educational goal of this Bachelor's program is to develop the skills to select and link fundamental methods and procedures in order to solve technical problems in the field of General Engineering science, especially in the selected subject area of specialisation.
Graduates have:
1) Sound knowledge in the subject areas mathematics, thermodynamics, mechanics, electrical Engineering and computer science.
2) A basic knowledge in the field of measurement and control engineering, fluid mechanics and materials science.
3) In-depth knowledge in Engineering applications, especially in the selected subject area of specialisation (product development and manufacturing, material science, aircrafts, energy Engineering, mechatronics, medical engineering, theoretical mechanical engineering). They have in particular the necessary methodological knowledge and its application to engineering problems, taking into account technical specifications and economic and social parameters.
4) The ability to work scientifically and to expand their specialized knowledge independently.
Graduates are able to work responsibly and competently as mechanical engineers, especially in occupations related to the selected subject area of specialisation.

Module: Mechanical Engineering: Design

Courses:

Title	Typ	Hrs/wk
Embodiment Design and 3D-CAD	Vorlesung	2
Mechanical Design Project I	Testat	3
Mechanical Design Project II	Testat	3
Team Project Design Methodology	Problemorientierte Lehrveranstaltung	2

Module Responsibility:
Prof. Dieter Krause

Admission Requirements:
None

Recommended Previous Knowledge:

- Fundamentals of Mechanical Engineering Design
- Mechanics
- Fundamentals of Materials Science
- Production Engineering

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
After passing the module, students are able to:

- explain design guidelines for machinery parts e.g. considering load situation, materials and manufacturing requirements,
- describe basics of 3D CAD,
- explain basics methods of engineering designing.

Capabilities:
After passing the module, students are able to:

- independently create sketches, technical drawings and documentations e.g. using 3D CAD,
- design components based on design guidelines autonomously,
- dimension (calculate) used components,
- use methods to design and solve engineering design tasks systamtically and solution-oriented,
- apply creativity techniques in teams.

Personal Competence:
Social Competence:
After passing the module, students are able to:

- develop and evaluate solutions in groups including making and documenting decisions,
- moderate the use of scientific methods,
- present and discuss solutions and technical drawings within groups,
- reflect the own results in the work groups of the course.

Autonomy:
Students are able

- to estimate their level of knowledge using activating methods within the lectures (e.g. with clickers),
- To solve engineering design tasks systematically.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 40, Study Time in Lecture: 140

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Biomedical Engineering: Compulsory
Energy and Environmental Engineering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Biomedical Engineering: Compulsory
Mechanical Engineering: Kernqualifikation: Compulsory
Mechatronics: Kernqualifikation: Compulsory
Naval Architecture: Kernqualifikation: Compulsory

Course: Embodiment Design and 3D-CAD (Vorlesung)

Lecturer:
Prof. Dieter Krause

Language:
DE

Cycle:
WS

Content:

- Basics of 3D CAD technology
- Practical course to apply a 3D CAD system
  - Introduction to the system
  - Sketching and creation of components
  - Creation of assemblies
  - Deriving technical drawings

Literature:

- CAx für Ingenieure eine praxisbezogene Einführung; Vajna, S., Weber, C., Bley, H., Zeman, K.; Springer-Verlag, aktuelle Auflage.
- Handbuch Konstruktion; Rieg, F., Steinhilper, R.; Hanser; aktuelle Auflage.
- Dubbel, Taschenbuch für den Maschinenbau; Grote, K.-H., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.
- Technisches Zeichnen: Grundlagen, Normen, Beispiele, Darstellende Geometrie, Hoischen, H; Hesser, W; Cornelsen, aktuelle Auflage.
- Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.
- Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.
- Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.
- Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.
- Maschinenelemente – Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.
- Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.

Course: Mechanical Design Project I (Testat)

Lecturer:
Prof. Thorsten Schüppstuhl

Language:
DE

Cycle:
WS

Content:

- Create a technical documentation of an existing mechanical model
- Consolidation of the following aspects of technical drawings:
  - Presentation of technical objects and standardized parts
    (bearings, seals, shaft-hub joints, detachable connections, springs, axes and shafts)
  - Sectional views
  - Dimensioning
  - Tolerances and surface specifications
  - Creating a tally sheet

Literature:

1. Hoischen, H.; Hesser, W.: Technisches Zeichnen. Grundlagen, Normen, Beispiele, darstellende Geometrie, 33. Auflage. Berlin 2011.
2. Labisch, S.; Weber, C.: Technisches Zeichnen. Selbstständig lernen und effektiv üben, 4. Auflage. Wiesbaden 2008.
3. Fischer, U.: Tabellenbuch Metall, 43. Auflage. Haan-Gruiten 2005.

Course: Mechanical Design Project II (Testat)

Lecturer:
Prof. Wolfgang Hintze

Language:
DE

Cycle:
SS

Content:

- Generation of sketches for functions and sub-functions
- Approximately calculation of shafts
- Dimension of bearings, screw connections and weld
- Generation of engineering drawings (assembly drawings, manufacturing drawing)

Literature:
Dubbel, Taschenbuch für Maschinenbau, Beitz, W., Küttner, K.-H, Springer-Verlag.
Maschinenelemente, Band I - III, Niemann, G., Springer-Verlag.
Maschinen- und Konstruktionselemente, Steinhilper, W., Röper, R., Springer-Verlag.
Einführung in die DIN-Normen, Klein, M., Teubner-Verlag.
Konstruktionslehre, Pahl, G., Beitz, W., Springer-Verlag.

Course: Team Project Design Methodology (Problemorientierte Lehrveranstaltung)

Lecturer:
Prof. Dieter Krause

Language:
DE

Cycle:
SS

Content:

- Introduction to engineering designing methodology
- Team Project Design Methodology
  - Creating requirement lists
  - Problem formulation
  - Creating functional structures
  - Finding solutions
  - Evaluation of the found concepts
  - Documentation of the taken methodological steps and the concepts using presentation slides

Literature:

- Dubbel, Taschenbuch für den Maschinenbau; Grote, K.-H., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.
- Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.
- Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.
- Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.
- Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.
- Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.
- Maschinenelemente – Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.
- Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.
- Sowie weitere Bücher zu speziellen Themen

Module: Fundamentals of Materials Science

Courses:

Title	Typ	Hrs/wk
Fundamentals of Materials Science I	Vorlesung	2
Fundamentals of Materials Science II (Advanced Ceramic Materials, Polymers and Composites)	Vorlesung	2
Physical and Chemical Basics of Materials Science	Vorlesung	2

Module Responsibility:
Prof. Jörg Weißmüller

Admission Requirements:
None

Recommended Previous Knowledge:
Highschool-level physics, chemistry und mathematics

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students have acquired a fundamental knowledge on metals, ceramics and polymers and can describe this knowledge comprehensively. Fundamental knowledge here means specifically the issues of atomic structure, microstructure, phase diagrams, phase transformations, corrosion and mechanical properties. The students know about the key aspects of characterization methods for materials and can identify relevant approaches for characterizing specific properties. They are able to trace materials phenomena back to the underlying physical and chemical laws of nature.

Capabilities:
The students are able to trace materials phenomena back to the underlying physical and chemical laws of nature. Materials phenomena here refers to mechanical properties such as strength, ductility, and stiffness, chemical properties such as corrosion resistance, and to phase transformations such as solidification, precipitation, or melting. The students can explain the relation between processing conditions and the materials microstructure, and they can account for the impact of microstructure on the material's behavior.

Personal Competence:
Social Competence:
-
Autonomy:
-

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 96, Study Time in Lecture: 84

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Naval Architecture: Compulsory
Energy and Environmental Engineering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Naval Architecture: Compulsory
Logistics and Mobility: Vertiefung Engineering Science: Compulsory suffrage
Mechanical Engineering: Kernqualifikation: Compulsory
Mechatronics: Kernqualifikation: Compulsory
Naval Architecture: Kernqualifikation: Compulsory
Technomathematics: Vertiefung Engineering Science: Compulsory suffrage

Course: Fundamentals of Materials Science I (Vorlesung)

Lecturer:
Prof. Jörg Weißmüller

Language:

DE

Cycle:
WS

Content:

Literature:
Vorlesungsskript
W.D. Callister: Materials Science and Engineering - An Introduction. 5th ed., John Wiley & Sons, Inc., New York, 2000, ISBN 0-471-32013-7

Course: Fundamentals of Materials Science II (Advanced Ceramic Materials, Polymers and Composites) (Vorlesung)

Lecturer:
Prof. Bodo Fiedler, Prof. Gerold Schneider

Language:
DE

Cycle:
SS

Content:
Chemische Bindungen und Aufbau von Festkörpern; Kristallaufbau; Werkstoffprüfung; Schweißbarkeit; Herstellung von Keramiken; Aufbau und Eigenschaften der Keramik; Herstellung, Aufbau und Eigenschaften von Gläsern; Polymerwerkstoffe, Makromolekularer Aufbau; Struktur und Eigenschaften der Polymere; Polymerverarbeitung; Verbundwerkstoffe

Literature:
Vorlesungsskript
W.D. Callister: Materials Science and Engineering -An Introduction-5th ed., John Wiley & Sons, Inc., New York, 2000, ISBN 0-471-32013-7

Course: Physical and Chemical Basics of Materials Science (Vorlesung)

Lecturer:
Prof. Stefan Müller

Language:
DE

Cycle:
WS

Content:

Literature:
Für den **Elektromagnetismus:**

- Bergmann-Schäfer: „Lehrbuch der Experimentalphysik“, Band 2: „Elektromagnetismus“, de Gruyter

Für die **Atomphysik:**

- Haken, Wolf: „Atom- und Quantenphysik“, Springer

Für die **Materialphysik und Elastizität:**

- Hornbogen, Warlimont: „Metallkunde“, Springer

Module: Electrical Machines

Courses:

Title	Typ	Hrs/wk
Electrical Machines	Vorlesung	3
Electrical Machines	Hörsaalübung	2

Module Responsibility:
Prof. Günter Ackermann

Admission Requirements:
none

Recommended Previous Knowledge:
Basics of mathematics, in particular complexe numbers, integrals, differentials
Basics of electrical engineering and mechanical engineering

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students can to draw and explain the basic principles of electric and magnetic fields.
They can describe the function of the standard types of electric machines and present the corresponding equations and characteristic curves.

Capabilities:
Students arw able to calculate two-dimensional electric and magnetic fields in particular ferromagnetic circuits with air gap. Fopr this they apply the usual methods of the design auf electric machines.
They can calulate the operational performance of electric machines from their given characteristic data and selected quantities and characteristic curves. They apply the usual equivalent circuits and graphical methods.

Personal Competence:
Social Competence:
none
Autonomy:
Students are able independently to calculate electric and magnatic fields for applications. They are able independently to analyse the operational performance of electric machines from the charactersitic data and they thereof can calculate selected quantities and characteristc curves.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 110, Study Time in Lecture: 70

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering: Compulsory suffrage
Electrical Engineering: Kernqualifikation: Compulsory suffrage
Electrical Engineering myTrack: Kernqualifikation: Compulsory suffrage
Energy and Environmental Engineering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering: Compulsory suffrage
Logistics and Mobility: Vertiefung Engineering Science: Compulsory suffrage
Mechanical Engineering: Kernqualifikation: Compulsory suffrage
Mechatronics: Kernqualifikation: Compulsory

Course: Electrical Machines (Vorlesung)

Lecturer:
Prof. Günter Ackermann

Language:
DE

Cycle:
SS

Content:

Electric field: Coulomb´s law, flux (field) line, work, potential, capacitor, energy, force
Magnetic field: force, flux line, Ampere´s law, field at bounderies, flux, magnetic circuit, hysteresis, induction, self-induction, mutual inductance, transformer
DC-Machines: Construction and layout, torque generation mechanismen, torque vs speed characteristics, commutation,
Asynchronous Machines. Magnetic field, construction and layout, equivalent single line diagram, complex stator current diagram (Heylands ´diagram), torque vs. speed characteristics, rotor layout (Squirrelcage vs. sliprings),
Synchronous machines, construction and layout, equivalent single line diagrams, no-load and short-cuircuit characteristics, vector diagrams, motor and generator operation
drives with variable speed, inverter fed operation, special drives, step motors,

Literature:

Hermann Linse, Roland Fischer: "Elektrotechnik für Maschinenbauer", Vieweg-Verlag; Signatur der Bibliothek der TUHH: ETB 313
Ralf Kories, Heinz Schmitt-Walter: "Taschenbuch der Elektrotechnik"; Verlag Harri Deutsch; Signatur der Bibliothek der TUHH: ETB 122
"Grundlagen der Elektrotechnik" - anderer Autoren
Fachbücher "Elektrische Maschinen"

Course: Electrical Machines (Übung)

Lecturer:

Prof. Günter Ackermann

Language:

DE

Cycle:

SS

Content:

Exercises to the application of electric and magnetic fields.
Excercises to the operational performance of eletric machines.

Literature:

Hermann Linse, Roland Fischer: "Elektrotechnik für Maschinenbauer", Vieweg-Verlag; Signatur der Bibliothek der TUHH: ETB 313
Ralf Kories, Heinz Schmitt-Walter: "Taschenbuch der Elektrotechnik"; Verlag Harri Deutsch; Signatur der Bibliothek der TUHH: ETB 122
"Grundlagen der Elektrotechnik" - anderer Autoren
Fachbücher "Elektrische Maschinen"

Module: Signals and Systems

Courses:

Title	Typ	Hrs/wk
Signals and Systems	Vorlesung	3
Signals and Systems	Hörsaalübung	1

Module Responsibility:
Prof. Gerhard Bauch

Admission Requirements:
Mathematics 1-3

Recommended Previous Knowledge:

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students are able to classify and describe signals and linear time-invariant (LTI) systems using methods of signal and system theory. They are able to apply the fundamental transformations of continuous-time and discrete-time signals and systems. They can describe and analyse deterministic signals and systems mathematically in both time and image domain. In particular, they understand the effects in time domain and image domain which are caused by the transition of a continuous-time signal to a discrete-time signal.
Capabilities:
The students are able to describe and analyse deterministic signals and linear time-invariant systems using methods of signal and system theory. They can analyse and design basic systems regarding important properties such as magnitude and phase response, stability, linearity etc.. They can assess the impact of LTI systems on the signal properties in time and frequency domain.

Personal Competence:
Social Competence:
The students can jointly solve specific problems.
Autonomy:
The students are able to acquire relevant information from appropriate literature sources. They can control their level of knowledge during the lecture period by solving tutorial problems, software tools, clicker system.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Electrical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Computer Science and Engineering: Compulsory
General Engineering Science (German program): Vertiefung Chemical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (German program): Vertiefung Civil- and Enviromental Engeneering: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Biomedical Engineering: Compulsory
Computer Science: Kernqualifikation: Compulsory
Electrical Engineering: Kernqualifikation: Compulsory
Electrical Engineering myTrack: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Civil- and Enviromental Engeneering: Compulsory
General Engineering Science (English program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (English program): Vertiefung Electrical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Computer Science and Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Chemical Engineering: Compulsory
Computational Science and Engineering: Kernqualifikation: Compulsory
Mechatronics: Kernqualifikation: Compulsory
Technomathematics: Vertiefung Engineering Science: Compulsory suffrage

Course: Signals and Systems (Vorlesung)

Lecturer:
Prof. Gerhard Bauch

Language:
DE/EN

Cycle:
SS

Content:

- Basic classification and description of continuous-time and discrete-time signals and systems
- Concvolution
- Power and energy of signals
- Correlation functions of deterministic signals
- Linear time-invariant (LTI) systems
- Signal transformations:
  - Fourier-Series
  - Fourier Transform
  - Laplace Transform
  - Discrete-time Fourier Transform
  - Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT)
  - Z-Transform
- Analysis and design of LTI systems in time and frequency domain
- Basic filter types
- Sampling, sampling theorem
- Fundamentals of recursive and non-recursive discrete-time filters

Literature:

- T. Frey , M. Bossert , Signal- und Systemtheorie, B.G. Teubner Verlag 2004
- K. Kammeyer, K. Kroschel, Digitale Signalverarbeitung, Teubner Verlag.
- B. Girod ,R. Rabensteiner , A. Stenger , Einführung in die Systemtheorie, B.G. Teubner, Stuttgart, 1997
- J.R. Ohm, H.D. Lüke , Signalübertragung, Springer-Verlag 8. Auflage, 2002
- S. Haykin, B. van Veen: Signals and systems. Wiley.
- Oppenheim, A.S. Willsky: Signals and Systems. Pearson.
- Oppenheim, R. W. Schafer: Discrete-time signal processing. Pearson.

Course: Signals and Systems (Übung)

Lecturer:
Prof. Gerhard Bauch

Language:
DE/EN

Cycle:
SS

Content:

- Basic classification and description of continuous-time and discrete-time signals and systems
- Concvolution
- Power and energy of signals
- Correlation functions of deterministic signals
- Linear time-invariant (LTI) systems
- Signal transformations:
  - Fourier-Series
  - Fourier Transform
  - Laplace Transform
  - Discrete-time Fourier Transform
  - Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT)
  - Z-Transform
- Analysis and design of LTI systems in time and frequency domain
- Basic filter types
- Sampling, sampling theorem
- Fundamentals of recursive and non-recursive discrete-time filters

Literature:

- T. Frey , M. Bossert , Signal- und Systemtheorie, B.G. Teubner Verlag 2004
- K. Kammeyer, K. Kroschel, Digitale Signalverarbeitung, Teubner Verlag.
- B. Girod ,R. Rabensteiner , A. Stenger , Einführung in die Systemtheorie, B.G. Teubner, Stuttgart, 1997
- J.R. Ohm, H.D. Lüke , Signalübertragung, Springer-Verlag 8. Auflage, 2002
- S. Haykin, B. van Veen: Signals and systems. Wiley.
- Oppenheim, A.S. Willsky: Signals and Systems. Pearson.
- Oppenheim, R. W. Schafer: Discrete-time signal processing. Pearson.

Module: Fluid Dynamics

Courses:

Title	Typ	Hrs/wk
Fluid Mechanics	Vorlesung	3
Fluid Mechanics	Hörsaalübung	1

Module Responsibility:
Prof. Heinz Herwig

Admission Requirements:
none

Recommended Previous Knowledge:
Technical Thermodynamics I, II

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students are able to
- distinguish the different physical mechanism of fluid dynamics,
- understand the different mathematic modeling of fluid flow,
- to apply and calculate fluid flow processes in different problems in nature and techniques.

Capabilities:
The students are able to
- understand the physics of Fluid Dynamics,
- calculate and evaluate complex Fluid Dynamics processes,
- solve excersises self-consistent and in small groups.

Personal Competence:
Social Competence:
The students are able to discuss in small groups and develop an approach.
Autonomy:
The students are able to develop a complex problem self-consistent and analyse the results in a critical way. A qualified exchange with other students is given.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Biomedical Engineering: Compulsory
Computational Science and Engineering: Vertiefung Engineering Sciences: Compulsory suffrage
Mechanical Engineering: Kernqualifikation: Compulsory

Course: Fluid Mechanics (Vorlesung)

Lecturer:
Prof. Heinz Herwig

Language:
DE

Cycle:
SS

Content:

- Overview
- Physical/mathematical modelling
- Special phenomena
- Basic equations of fluid dynamics
- The turbulence problem
- One dimensional theory for inkompressibel flows
- One dimensional theory for kompressibel flows
- Flow over contours without friction

- Flow over contours with friction
- Flow through channels
- Simplified equations for three dimensional flow
- Special aspects of the numerical solution for complex flows

Literature:

- Herwig, H.: Strömungsmechanik, 2. Auflage, Springer- Verlag, Berlin, Heidelberg, 2006
- Herwig, H.: Strömungsmechanik von A-Z, Vieweg Verlag, Wiesbaden, 2004

Course: Fluid Mechanics (Übung)

Lecturer:
Prof. Heinz Herwig

Language:
DE

Cycle:
SS

Content:

- Overview
- Physical/mathematical modelling
- Special phenomena
- Basic equations of fluid dynamics
- The turbulence problem
- One dimensional theory for inkompressibel flows
- One dimensional theory for kompressibel flows
- Flow over contours without friction
- Flow over contours with friction
- Flow through channels
- Simplified equations for three dimensional flow
- Special aspects of the numerical solution for complex flows

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- Herwig, H.: Strömungsmechanik von A-Z, Vieweg Verlag, Wiesbaden, 2004

Module: Fundamentals of Production and Quality Management

Courses:

Title	Typ	Hrs/wk
Production Process Organization	Vorlesung	2
Quality Management	Vorlesung	2

Module Responsibility:
Prof. Hermann Lödding

Admission Requirements:
none

Recommended Previous Knowledge:
Fundamentals of Production and Quality Management

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students are able to explain the contents of the lecture of the module.
Capabilities:
Students are able to apply the methods and models in the module to industrial problems.

Personal Competence:
Social Competence:
-
Autonomy:
-

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Mechanical Engineering: Compulsory suffrage
General Engineering Science (English program): Vertiefung Mechanical Engineering: Compulsory suffrage
Logistics and Mobility: Vertiefung Engineering Science: Compulsory suffrage
Mechanical Engineering: Kernqualifikation: Compulsory suffrage

Course: Production Process Organization (Vorlesung)

Lecturer:
Prof. Hermann Lödding

Language:
EN

Cycle:
SS

Content:
(A) Introduction
(B) Product planning
(C) Process planning
(D) Procurement
(E) Manufacturing
(F) Production planning and control (PPC)
(G) Distribution
(H) Cooperation

Literature:
Wiendahl, H.-P.: Betriebsorganisation für Ingenieure
Vorlesungsskript

Course: Quality Management (Vorlesung)

Lecturer:
Prof. Hermann Lödding

Language:
EN

Cycle:
SS

Content:

- Definition and Relevance of Quality
- Continuous Quality Improvement
- Quality Management in Product Development
- Quality Management in Production Processes
- Design of Experiments

Literature:

- Pfeifer, Tilo: Quality Management. Strategies, Methods, Techniques; Hanser-Verlag, München 2002
- Pfeifer, Tilo: Qualitätsmanagement. Strategien, Methoden, Techniken; Hanser-Verlag, München, 3. Aufl. 2001
- Mitra, Amitava: Fundamentals of Quality Control and Improvement; Wiley; Macmillan, 2008
- Kleppmann, W.: Taschenbuch Versuchsplanung. Produkte und Prozesse optimieren; Hanser-Verlag, München, 6. Aufl. 2009

Module: Advanced Materials

Courses:

Title	Typ	Hrs/wk
Advanced Materials Characterization	Vorlesung	2
Advanced Materials Design	Vorlesung	2
Advanced Materials Design	Hörsaalübung	2

Module Responsibility:
Prof. Patrick Huber

Admission Requirements:
none

Recommended Previous Knowledge:
Fundamentals of Materials Science (I and II)

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students will be able to explain the properties of advanced materials along with their applications in technology, in particular metallic, ceramic, polymeric, semiconductor, modern composite materials (biomaterials) and nanomaterials.
Capabilities:
The students will be able to select material configurations according to the technical needs and, if necessary, to design new materials considering architectural principles from the micro- to the macroscale. The students will also gain an overview on modern materials science, which enables them to select optimum materials combinations depending on the technical applications.

Personal Competence:
Social Competence:
The students are able to present solutions to specialists and to develop ideas further.

Autonomy:
The students are able to ...

- assess their own strengths and weaknesses.
- define tasks independently.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 96, Study Time in Lecture: 84

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Mechanical Engineering: Compulsory suffrage
General Engineering Science (English program): Vertiefung Mechanical Engineering: Compulsory suffrage
Mechanical Engineering: Kernqualifikation: Compulsory suffrage

Course: Advanced Materials Characterization (Vorlesung)

Lecturer:
Prof. Patrick Huber

Language:
DE

Cycle:
SS

Content:
1. Porous Solids - Preparation, Characterization and Functionalities
2. Fluidics with nanoporous membranes
3. X-ray diffraction for microstructure analysis
4. Thermoplastic elastomers
5. Optimization of polymer properties by nanoparticles
6. Fiber composites in automotive
7. Modeling of materials based on quantum mechanics
8. Mechanical properties of biomaterials

Literature:

William D. Callister und David G. Rethwisch, Materialwissenschaften und Werkstofftechnik, Wiley&Sons, Asia (2011).
William D. Callister, Materials Science and Technology, Wiley& Sons, Inc. (2007).

Course: Advanced Materials Design (Vorlesung)

Lecturer:

Prof. Bodo Fiedler, Prof. Stefan Müller, Prof. Patrick Huber, Prof. Gerold Schneider, Prof. Jörg Weißmüller

Language:

DE/EN

Cycle:

SS

Content:

Aluminiumlegierungen im Flugzeugbau:
Korrosionsbeständige Varianten, Legierungen mit niedriger Dichte und hoher Steifigkeit; Ermüdungseigenschaften unter einsatznahen Belastungsbedingungen
Titanlegierungen im Flugzeugbau:
Hochtemperaturlegierungen für Flugtriebwerke (Kompressor):
Optimierung von Kriech- und Schwingfestigkeit;
höchstfeste Legierungen für Flugzeugstrukturbauteile:
Optimierung von Streckgrenze und Bruchzähigkeit
Demonstrationsversuche an Aluminium- und Titanlegierungen im Labor
Metall-Keramik-Verbundwerkstoffe:
spezifische Vor- und Nachteile
Herstellung von Funktionskeramiken:
Multilayer-Keramik für Aktoren in der Mikropositionierungstechnik am Beispiel der PZT-Keramik
mechanische und elektrische Zuverlässigkeit von Funktionskeramiken
neue Entwicklungen bei den Polymerlegierungen:
z.B. thermoplastische Elastomere
Polymer/Polymer-Verbundwerkstoffe:
z.B. PE-Faser verstärktes PE
biologisch abbaubare Polymere und polymere Verbundwerkstoffe:
z.B. Flachsfasern in Polycaprolakton
Aufbau und Eigenschaften intermetallischer Aluminide (auf Basis Fe, Ni, Ti)
Herstellung und Anwendungen von intermetallischen Legierungen
Phasen- und Gefügeanalyse eines Verbundwerkstoffes auf Basis intermetallischer Phasen (mit Laborübung)

Literature:

Vorlesungsunterlagen

Course: Advanced Materials Design (Übung)

Lecturer:

Prof. Bodo Fiedler, Prof. Stefan Müller, Prof. Patrick Huber, Prof. Gerold Schneider, Prof. Jörg Weißmüller

Language:

DE/EN

Cycle:

SS

Content:

Aluminiumlegierungen im Flugzeugbau:
Korrosionsbeständige Varianten, Legierungen mit niedriger Dichte und hoher Steifigkeit; Ermüdungseigenschaften unter einsatznahen Belastungsbedingungen
Titanlegierungen im Flugzeugbau:
Hochtemperaturlegierungen für Flugtriebwerke (Kompressor):
Optimierung von Kriech- und Schwingfestigkeit;
höchstfeste Legierungen für Flugzeugstrukturbauteile:
Optimierung von Streckgrenze und Bruchzähigkeit
Demonstrationsversuche an Aluminium- und Titanlegierungen im Labor
Metall-Keramik-Verbundwerkstoffe:
spezifische Vor- und Nachteile
Herstellung von Funktionskeramiken:
Multilayer-Keramik für Aktoren in der Mikropositionierungstechnik am Beispiel der PZT-Keramik
mechanische und elektrische Zuverlässigkeit von Funktionskeramiken
neue Entwicklungen bei den Polymerlegierungen:
z.B. thermoplastische Elastomere
Polymer/Polymer-Verbundwerkstoffe:
z.B. PE-Faser verstärktes PE

biologisch abbaubare Polymere und polymere Verbundwerkstoffe:
z.B. Flachsfasern in Polycaprolakton
Aufbau und Eigenschaften intermetallischer Aluminide (auf Basis Fe, Ni, Ti)
Herstellung und Anwendungen von intermetallischen Legierungen
Phasen- und Gefügeanalyse eines Verbundwerkstoffes auf Basis intermetallischer Phasen (mit Laborübung)

Literature:

Vorlesungsunterlagen

Module: Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems)

Courses:

Title	Typ	Hrs/wk
Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems)	Vorlesung	3
Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems)	Gruppenübung	2
Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems)	Hörsaalübung	1

Module Responsibility:
NN

Admission Requirements:
none

Recommended Previous Knowledge:
Mechanics I (Statics) and Mechanics III (Hydrostatics, Kinematics, Dynamics)
Mathematics I and II

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students can

- describe the axiomatic procedure used in mechanical contexts;
- explain important steps in model design;
- present technical knowledge.

Capabilities:
The students can

- explain the important elements of mathematical / mechanical analysis and model formation, and apply it to the context of their own problems;
- apply basic methods to engineering problems;
- estimate the reach and boundaries of the methods and extend them to be applicable to wider problem sets.

Personal Competence:
Social Competence:
The students can work in groups and support each other to overcome difficulties.
Autonomy:
Students are capable of determining their own strengths and weaknesses and to organize their time and learning based on those.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 96, Study Time in Lecture: 84

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Naval Architecture: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Naval Architecture: Compulsory
Mechanical Engineering: Kernqualifikation: Compulsory
Mechatronics: Kernqualifikation: Compulsory
Naval Architecture: Kernqualifikation: Compulsory
Technomathematics: Kernqualifikation: Compulsory suffrage

Course: Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems) (Vorlesung)

Lecturer:
NN

Language:
DE

Cycle:

SS

Content:

- Simple impact problems
- Principles of analytical mechanics
- Elements of vibration theory
- Basics of continuum vibrations
- Introduction into Modeling of Multibody Systems

Literature:

K. Magnus, H.H. Müller-Slany: Grundlagen der Technischen Mechanik. 7. Auflage, Teubner (2009).
D. Gross, W. Hauger, J. Schröder, W. Wall: Technische Mechanik 1-4. 11. Auflage, Springer (2011).

Course: Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems) (Übung)

Lecturer:

NN

Language:

DE

Cycle:

SS

Content:

- Simple impact problems
- Principles of analytical mechanics
- Elements of vibration theory
- Basics of continuum vibrations
- Introduction into Modeling of Multibody Systems

Literature:

K. Magnus, H.H. Müller-Slany: Grundlagen der Technischen Mechanik. 7. Auflage, Teubner (2009).
D. Gross, W. Hauger, J. Schröder, W. Wall: Technische Mechanik 1-4. 11. Auflage, Springer (2011).

Course: Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems) (Übung)

Lecturer:

NN

Language:

DE

Cycle:

SS

Content:

- Simple impact problems
- Principles of analytical mechanics
- Elements of vibration theory
- Basics of continuum vibrations
- Introduction into Modeling of Multibody Systems

Literature:

K. Magnus, H.H. Müller-Slany: Grundlagen der Technischen Mechanik. 7. Auflage, Teubner (2009).
D. Gross, W. Hauger, J. Schröder, W. Wall: Technische Mechanik 1-4. 11. Auflage, Springer (2011).

Module: Measurement Technology for Mechanical and Process Engineers

Courses:

Title	Typ	Hrs/wk
Practical Course: Measurement and Control Systems	Laborpraktikum	2
Measurement Technology for Mechanical and Process Engineers	Vorlesung	2
Measurement Technology for Mechanical and Process Engineers	Hörsaalübung	1

Module Responsibility:
NN

Admission Requirements:
none

Recommended Previous Knowledge:
Basic knowledge of physics, chemistry and electrical engineering

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students are able to name the most important fundmentals of the Measurement Technology (Quantities and Units, Uncertainty, Calibration, Static and Dynamic Properties of Sensors and Systems).
They can outline the most important measuring methods for different kinds of quantities to be maesured (Electrical Quantities, Temperature, mechanical quantities, Flow, Time, Frequency).
They can describe important methods of chemical Analysis (Gas Sensors, Spectroscopy, Gas Chromatography)

Capabilities:
Students can select suitable measuring methods to given problems and can use refering measurement devices in practice.

Personal Competence:
Social Competence:
Students can arrive at work results in groups and document them in a common report.

Autonomy:
Students are able to familiarize themselves with new measurement technologies.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 110, Study Time in Lecture: 70

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Biomedical Engineering: Compulsory
Energy and Environmental Engineering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Biomedical Engineering: Compulsory
Mechanical Engineering: Kernqualifikation: Compulsory
Mechatronics: Kernqualifikation: Compulsory

Course: Practical Course: Measurement and Control Systems (Laborpraktikum)

Lecturer:
NN

Language:
DE

Cycle:
WS/SS

Content:
Experiment 1: Emission and immission measurement of gaseous pollutants: different technologies to determine different gaseous pollutants in automotive exhaust are used.
Experiment 2: Simulation and measurement of asynchrone engine and rotary pump: the dynamic behaviour of e pump engine will be investigated. The starting will be simulated on a PC and compared with measurement.
Experiment 3: Michelson interferometer and fiber optic: fundamental optical phenonema will be understood and applications with Michelson

interferometer and optical fibers demonstrated.
Experiment 4:Identification of the parameters of a control system and optimal control parameters

Literature:

Versuch 1:

- Leith, W.: Die Analyse der Luft und ihrer Verunreinigung in der freien Atmosphäre und am Arbeitsplatz. 2. Aufl., Wissenschaftliche Verlagsgesellschaft, Stuttgart, 1974
- Birkle, M.: Meßtechnik für den Immissionsschutz, Messen der gas- und partikelförmigen Luftverunreinigungen. R. Oldenburg Verlag, München-Wien, 1979
- Luftbericht 83/84, Freie und Hansestadt Hamburg, Behörde für Bezirksangelegenheiten, Naturschutz und Umweltgestaltung
- Gebrauchs- und Bedienungsanweisungen
- VDI-Handbuch Reinhaltung der Luft, Band 5: VDI-Richtlinien 2450 Bl.1, 2451 Bl.4, 2453 Bl.5, 2455 Bl.1

Versuch 2:

- Grundlagen über elektrische Maschinen, speziell: Asynchronmotoren
- Simulationsmethoden, speziell: Verwendung von Blockschaltbildern
- Betriebsverhalten von Kreispumpen, speziell: Kennlinien, Ähnlichkeitsgesetze

Versuch 3:

- Unger, H.-G.: Optische Nachrichtentechnik, Teil 1: Optische Wellenleiter. Hüthing Verlag, Heidelberg, 1984
- Dakin, J., Cushaw, B.: Optical Fibre Sensors: Principles and Components. Artech House Boston, 1988
- Culshaw, B., Dakin, J.: Optical Fibre Sensors: Systems and Application. Artech House Boston, 1989

Versuch 4:

- Leonhard: Einführung in die Regelungstechnik. Vieweg Verlag, Braunschweig-Wiesbaden
- Jan Lunze: Systemtheoretische Grundlagen, Analyse und Entwurf einschleifiger Regelungen

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Course: Measurement Technology for Mechanical and Process Engineers (Vorlesung)

Lecturer:
NN

Language:
DE

Cycle:
WS

Content:
1 Fundamentals
1.1 Quantities and Units
1.2 Uncertainty
1.3 Calibration
1.4 Static and Dynamic Properties of Sensors and Systems
2 Measurement of Electrical Quantities
2.1 Current and Voltage
2.2 Impedance
2.3 Amplification
2.4 Oscilloscope
2.5 Analog-to-Digital Conversion
2.6 Data Transmission
3 Measurement of Nonelectric Quantities
3.1 Temperature
3.2 Length, Displacement, Angle
3.3 Strain, Force, Pressure
3.4 Flow
3.5 Time, Frequency
4 Chemical Analysis
4.1 Gas Sensors
4.2 Spectroscopy
4.3 Gas Chromatography

Literature:
Lerch, R.: „Elektrische Messtechnik; Analoge, digitale und computergestützte Verfahren“, Springer, 2006, ISBN: 978-3-540-34055-3.
Profos, P. Pfeifer, T.: „Handbuch der industriellen Messtechnik“, Oldenbourg, 2002, ISBN: 978-3486217940.

Course: Measurement Technology for Mechanical and Process Engineers (Übung)

Lecturer:

NN

Language:

DE

Cycle:

WS

Content:

1 Fundamentals
1.1 Quantities and Units
1.2 Uncertainty
1.3 Calibration
1.4 Static and Dynamic Properties of Sensors and Systems
2 Measurement of Electrical Quantities
2.1 Current and Voltage
2.2 Impedance
2.3 Amplification
2.4 Oscilloscope
2.5 Analog-to-Digital Conversion
2.6 Data Transmission
3 Measurement of Nonelectric Quantities
3.1 Temperature
3.2 Length, Displacement, Angle
3.3 Strain, Force, Pressure
3.4 Flow
3.5 Time, Frequency
4 Chemical Analysis
4.1 Gas Sensors
4.2 Spectroscopy
4.3 Gas Chromatography

Literature:

Lerch, R.: „Elektrische Messtechnik; Analoge, digitale und computergestützte Verfahren“, Springer, 2006, ISBN: 978-3-540-34055-3.
Profos, P. Pfeifer, T.: „Handbuch der industriellen Messtechnik“, Oldenbourg, 2002, ISBN: 978-3486217940.

Courses:

Title	Typ	Hrs/wk
Introduction to Management	Vorlesung	4
Project Entrepreneurship	Problemorientierte Lehrveranstaltung	2

Module Responsibility:
Prof. Kathrin Fischer

Admission Requirements:
None

Recommended Previous Knowledge:
Basic Knowledge of Mathematics and Business

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
After taking this module, students know the important basics of many different areas in Business and Management, from Planning and Organisation to Marketing and Innovation, and also to Investment and Controlling. In particular they are able to

- explain the differences between Economics and Management and the sub-disciplines in Management and to name important definitions from the field of Management
- explain the most important aspects of and goals in Management and name the most important aspects of entreprneurial projects
- describe and explain basic business functions as production, procurement and sourcing, supply chain management, organization and human ressource management, information management, innovation management and marketing
- explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives and uncertainty, and explain some basic methods from mathematical Finance
- state basics from accounting and costing and selected controlling methods.

Capabilities:
Students are able to analyse business units with respect to different criteria (organization, objectives, strategies etc.) and to carry out an Entrepreneurship project in a team. In particular, they are able to

- analyse Management goals and structure them appropriately
- analyse organisational and staff structures of companies
- apply methods for decision making under multiple objectives, under uncertainty and under risk
- analyse production and procurement systems and Business information systems
- analyse and apply basic methods of marketing
- select and apply basic methods from mathematical finance to predefined problems
- apply basic methods from accounting, costing and controlling to predefined problems

Personal Competence:
Social Competence:
Students are able to

- work successfully in a team of students
- to apply their knowledge from the lecture to an entrepreneurship project and write a coherent report on the project
- to communicate appropriately and
- to cooperate respectfully with their fellow students.

Autonomy:
Students are able to

- work in a team and to organize the team themselves
- to write a report on their project.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 96, Study Time in Lecture: 84

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Electrical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Computer Science and Engineering: Compulsory
General Engineering Science (German program): Vertiefung Chemical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Bioprocess Engineering: Compulsory

General Engineering Science (German program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (German program): Vertiefung Civil- and Enviromental Engeneering: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Naval Architecture: Compulsory
Civil- and Environmental Engeneering: Kernqualifikation: Compulsory
Bioprocess Engineering: Kernqualifikation: Compulsory
Computer Science: Kernqualifikation: Compulsory
Electrical Engineering: Kernqualifikation: Compulsory
Electrical Engineering myTrack: Kernqualifikation: Compulsory
Energy and Environmental Engineering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Civil- and Enviromental Engeneering: Compulsory
General Engineering Science (English program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (English program): Vertiefung Electrical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (English program): Vertiefung Computer Science and Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Naval Architecture: Compulsory
General Engineering Science (English program): Vertiefung Chemical Engineering: Compulsory
Computational Science and Engineering: Kernqualifikation: Compulsory
Logistics and Mobility: Kernqualifikation: Compulsory
Mechanical Engineering: Kernqualifikation: Compulsory
Mechatronics: Kernqualifikation: Compulsory
Naval Architecture: Kernqualifikation: Compulsory
Technomathematics: Kernqualifikation: Compulsory
Process Engineering: Kernqualifikation: Compulsory

Course: Introduction to Management (Vorlesung)

Lecturer:
Prof. Kathrin Fischer, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Cornelius Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona

Language:
DE

Cycle:
WS/SS

Content:

- Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management
- Important definitions from Management,
- Developing Objectives for Business, and their relation to important Business functions
- Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supply Chain Management, Innovation Management, Marketing and Sales
  Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management
- Definitions as information, information systems, aspects of data security and strategic information systems
- Definition and Relevance of innovations, e.g. innovation opporunities, risks etc.
- Relevance of marketing, B2B vs. B2C-Marketing
- different techniques from the field of marketing (e.g. scenario technique), pricing strategies
- important organizational structures
- basics of human ressource management
- Introduction to Business Planning and the steps of a planning process
- Decision Analysis: Elements of decision problems and methods for solving decision problems
- Selected Planning Tasks, e.g. Investment and Financial Decisions
- Introduction to Accounting: Accounting, Balance-Sheets, Costing
- Relevance of Controlling and selected Controlling methods
- Important aspects of Entrepreneurship projects

Literature:
Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008
Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003
Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006.
Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001.
Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgart 2008.
Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeine Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005.
Weber, J., Schäffer, U. : Einführung in das Controlling, 12. Auflage, Stuttgart 2008.
Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006.

Course: Project Entrepreneurship (Problemorientierte Lehrveranstaltung)

Lecturer:
Prof. Christoph Ihl

Language:
DE

Cycle:
WS/SS

Content:
In this project module, students work on an Entrepreneurship project. They are required to go through all relevant steps, from the first idea to the concept, using their knowledge from the corresponding lecture.
Project work is carried out in teams with the support of a mentor.

Literature:
Relevante Literatur aus der korrespondierenden Vorlesung.

Focus Biomechanics

Module: MED I: Medical Basics I

Courses:

Title	Typ	Hrs/wk
Introduction to Anatomy	Vorlesung	2
Introduction to Radiology and Radiation Therapy	Vorlesung	2

Module Responsibility:
Prof. Michael Morlock

Admission Requirements:
None

Recommended Previous Knowledge:

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Therapy
The students can distinguish different types of currently used equipment with respect to its use in radiation therapy.
The students can explain complex treatment plans used in radiation therapy in interdisciplinary contexts (e.g. surgery, internal medicine).
The students can describe the patients' passage from their initial admittance through to follow-up care.
Diagnostics
The students can illustrate the technical base concepts of projection radiography, including angiography and mammography, as well as sectional imaging techniques (CT, MRT, US).
The students can explain the diagnostic as well as therapeutic use of imaging techniques, as well as the technical basis for those techniques.
The students can choose the right treatment method depending on the patient's clinical history and needs.
The student can explain the influence of technical errors on the imaging techniques.
The student can draw the right conclusions based on the images' diagnostic findings or the error protocol.
Anatomy
The students can describe
basal structures and functions of internal organs and the musculoskeletal system
.
The students can describe the basic macroscopy and microscopy of those systems.
Capabilities:
Therapy
The students can distinguish curative and palliative situations and motivate why they came to that conclusion.
The students can develop adequate therapy concepts and relate it to the radiation biological aspects.
The students can use the therapeutic principle (effects vs adverse effects)
The students can distinguish different kinds of radiation, can choose the best one depending on the situation (location of the tumor) and choose the energy needed in that situation (irradiation planning).
The student can assess what an individual psychosocial service should look like (e.g. follow-up treatment, sports, social help groups, self-help groups, social services, psycho-oncology).
Diagnostics
The students can suggest solutions for repairs of imaging instrumentation after having done error analyses.
The students can classify results of imaging techniques according to different groups of diseases based on their knowledge of anatomy, pathology and pathophysiology.
Anatomy
The students can recognize the relationship between given anatomical facts and the development of common diseases; they can explain the relevance of structures and their functions in the context of widespread diseases.

Personal Competence:
Social Competence:
The students can assess the special social situation of tumor patients and interact with them in a professional way.
The students are aware of the special, often fear-dominated behavior of sick people caused by diagnostic and therapeutic measures and can meet them appropriately.
The students can participate in current discussions in biomedical research and medicine on a professional level.
Autonomy:
The students can apply their new knowledge and skills to a concrete therapy case.
The students can introduce younger students to the clinical daily routine.
The students are able to access anatomical knowledge by themselves, can participate competently in conversations on the topic and acquire the relevant knowledge themselves.

ECTS-Credit points:
6 LP

Examination:

Klausur

Workload in Hours:

Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:

General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Biomechanics: Compulsory
General Engineering Science (German program): Vertiefung Biomedical Engineering: Compulsory
Electrical Engineering: Vertiefung Medical Technology: Compulsory suffrage
General Engineering Science (English program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Biomechanics: Compulsory
Mechanical Engineering: Vertiefung Biomechanics: Compulsory
Technomathematics: Vertiefung Engineering Science: Compulsory suffrage

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Course: Introduction to Anatomy (Vorlesung)

Lecturer:

Prof. Udo Schumacher

Language:

DE

Cycle:

SS

Content:

General Anatomy

1st week:	**The Eucaryote Cell**
2nd week:	**The Tissues**
3rd week:	**Cell Cycle, Basics in Development**
4th week:	**Musculoskeletal System**
5th week:	**Cardiovascular System**
6th week:	**Respiratory System**
7th week:	**Genito-urinary System**
8th week:	**Immune system**
9th week:	**Digestive System I**
10th week:	**Digestive System II**
11th week:	**Endocrine System**
12th week:	**Nervous System**
13th week:	**Exam**

Literature:

Adolf Faller/Michael Schünke, Der Körper des Menschen, 16. Auflage, Thieme Verlag Stuttgart, 2012

Course: Introduction to Radiology and Radiation Therapy (Vorlesung)

Lecturer:

Prof. Ulrich Carl, Prof. Thomas Vestring

Language:

DE

Cycle:

SS

Content:

The students will be given an understanding of the technological possibilities in the field of medical imaging, interventional radiology and radiation therapy/radiation oncology. It is assumed, that students in the beginning of the course have heard the word “X-ray” at best. It will be distinguished between the two arms of diagnostic (Prof. Dr. med. Thomas Vestring) and therapeutic (Prof. Dr. med. Ulrich Carl) use of X-rays. Both arms depend on special big units, which determine a predefined sequence in their respective departments

Literature:

- "Technik der medizinischen Radiologie" von T. + J. Laubenberg –
  7. Auflage – Deutscher Ärzteverlag – erschienen 1999
- "Klinische Strahlenbiologie" von Th. Herrmann, M. Baumann und W. Dörr –
  4. Auflage - Verlag Urban & Fischer – erschienen 02.03.2006
  ISBN: 978-3-437-23960-1

- "Strahlentherapie und Onkologie für MTA-R" von R. Sauer –
  5. Auflage 2003 - Verlag Urban & Schwarzenberg – erschienen 08.12.2009
  ISBN: 978-3-437-47501-6

- "Taschenatlas der Physiologie" von S. Silbernagel und A. Despopoulus
  8. Auflage – Georg Thieme Verlag - erschienen 19.09.2012
  ISBN: 978-3-13-567708-8

- "Der Körper des Menschen " von A. Faller u. M. Schünke -
  16. Auflage 2004 – Georg Thieme Verlag – erschienen 18.07.2012
  ISBN: 978-3-13-329716-5

- „Praxismanual Strahlentherapie“ von Stöver / Feyer –
  1. Auflage - Springer-Verlag GmbH – erschienen 02.06.2000

Courses:

Title	Typ	Hrs/wk
Experimental Methods in Biomechanics	Nicht definiert	2
Implants and Fracture Healing	Vorlesung	2

Module Responsibility:
Prof. Michael Morlock

Admission Requirements:
None

Recommended Previous Knowledge:
It is recommended to participate in "Implantate und Frakturheilung" before attending "Experimentelle Methoden".

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students can describe the different ways how bones heal, and the requirements for their existence.
The students can name different treatments for the spine and hollow bones under given fracture morphologies.
The students can describe different measurement techniques for forces and movements, and choose the adequate technique for a given task.
Capabilities:
The students can determine the forces acting within the human body under quasi-static situations under specific assumptions.
The students can describe the basic handling of several experimental techniques used in biomechanics.

Personal Competence:
Social Competence:
The students can, in groups, solve basic experimental tasks.
Autonomy:
The students can, in groups, solve basic experimental tasks.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Biomechanics: Compulsory
General Engineering Science (German program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Biomechanics: Compulsory
Mechanical Engineering: Vertiefung Biomechanics: Compulsory
Technomathematics: Vertiefung Engineering Science: Compulsory suffrage

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Course: Experimental Methods in Biomechanics ()

Lecturer:
Prof. Michael Morlock

Language:
DE

Cycle:
SS

Content:

Literature:

Course: Implants and Fracture Healing (Vorlesung)

Lecturer:
Prof. Michael Morlock

Language:
DE

Cycle:
WS

Content:

Topics to be covered include:

1. Introduction (history, definitions, background importance)
2. Bone (anatomy, properties, biology, adaptations in femur, tibia, humerus, radius)
3. Spine (anatomy, biomechanics, function, vertebral bodies, intervertebral disc, ligaments)

3.1 The spine in its entirety
3.2 Cervical spine
3.3 Thoracic spine
3.4 Lumbar spine
3.5 Injuries and diseases

4. Pelvis (anatomy, biomechanics, fracture treatment)

5 Fracture Healing
5.1 Basics and biology of fracture repair
5.2 Clinical principals and terminology of fracture treatment
5.3 Biomechanics of fracture treatment
5.3.1 Screws
5.3.2 Plates
5.3.3 Nails
5.3.4 External fixation devices
5.3.5 Spine implants
6.0 New Implants

Literature:

Cochran V.B.: Orthopädische Biomechanik
Mow V.C., Hayes W.C.: Basic Orthopaedic Biomechanics
White A.A., Panjabi M.M.: Clinical biomechanics of the spine
Nigg, B.: Biomechanics of the musculo-skeletal system
Schiebler T.H., Schmidt W.: Anatomie
Platzer: dtv-Atlas der Anatomie, Band 1 Bewegungsapparat

Courses:

Title	Typ	Hrs/wk
Introduction to Biochemistry and Molecular Biology	Vorlesung	2
Introduction to Physiology	Vorlesung	2

Module Responsibility:
Prof. Michael Morlock

Admission Requirements:

Recommended Previous Knowledge:

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students can

- describe basic biomolecules;
- explain how genetic information is coded in the DNA;
- explain the connection between DNA and proteins;
- describe the basics of the energy metabolism;
- explain pathobiochemical connections for certain common (tumors, diabetes, infections diseases) and some rarer genetic diseases; and
- describe physiological connections in select fields of muscle, heart/circulation, neuro- and sensory physiology.

Capabilities:
The students can

- recognize the importance of molecular parameters for the course of a disease;
- describe different molecular-diagnostic treatments;
- describe the importance of those treatments for some diseases; and
- describe the effects of basic bodily functions (sensory, transmission and processing of information, development of forces and vital functions) and relate them to similar technical systems.

Personal Competence:
Social Competence:
The students can conduct discussions in research and medicine on a technical level.
The students can find solutions to problems in the field of physiology, both analytical and metrological.
Autonomy:
The students can develop understanding of topics from the course, using technical literature, by themselves

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Biomechanics: Compulsory
General Engineering Science (German program): Vertiefung Biomedical Engineering: Compulsory
Electrical Engineering: Vertiefung Medical Technology: Compulsory suffrage
General Engineering Science (English program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Biomechanics: Compulsory
Mechanical Engineering: Vertiefung Biomechanics: Compulsory
Technomathematics: Kernqualifikation: Compulsory suffrage

Course: Introduction to Biochemistry and Molecular Biology (Vorlesung)

Lecturer:
Dr. Hans-Jürgen Kreienkamp

Language:
DE

Cycle:
WS/SS

Content:

Literature:

Müller-Esterl, Biochemie, Spektrum Verlag, 2010; 2. Auflage
Löffler, Basiswissen Biochemie, 7. Auflage, Springer, 2008

Course: Introduction to Physiology (Vorlesung)

Lecturer:

Dr. Roger Zimmermann

Language:

DE

Cycle:

SS

Content:

Literature:

Taschenatlas der Physiologie, Silbernagl Despopoulos, ISBN 978-3-135-67707-1, Thieme
Repetitorium Physiologie, Speckmann, ISBN 978-3-437-42321-5, Elsevier

Courses:

Title	Typ	Hrs/wk
Numerical Mathematics I	Vorlesung	2
Numerical Mathematics I	Gruppenübung	2

Module Responsibility:
Prof. Sabine Le Borne

Admission Requirements:

- Mathematik I + II for Engineering Students (german or english)

or

- Analysis & Linear Algebra I + II for Technomathematicians

Recommended Previous Knowledge:

- Lecture material of prerequisite lectures
- basic MATLAB knowledge

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students are able to

- name numerical methods for interpolation, integration, least squares problems, eigenvalue problems, nonlinear root finding problems and to explain their core ideas,
- repeat convergence statements for the numerical methods,
- explain aspects for the practical execution of numerical methods with respect to computational and storage complexitx.

Capabilities:
Students are able to

- implement, apply and compare numerical methods using MATLAB,
- justify the convergence behaviour of numerical methods with respect to the problem and solution algorithm,
- select and execute a suitable solution approach for a given problem.

Personal Competence:
Social Competence:
Students are able to

- work together in heterogeneously composed teams (i.e., teams from different study programs and background knowledge), explain theoretical foundations and support each other with practical aspects regarding the implementation of algorithms.

Autonomy:
Students are capable

- to assess whether the supporting theoretical and practical excercises are better solved individually or in a team,
- to assess their individual progess and, if necessary, to ask questions and seek help.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Computer Science and Engineering: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Biomechanics: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Materials in Engineering Sciences: Compulsory
General Engineering Science (German program): Vertiefung Biomedical Engineering: Compulsory
Bioprocess Engineering: Vertiefung A - General Bioprocess Engineering: Compulsory suffrage
Computer Science: Vertiefung Computational Mathematics: Compulsory suffrage
Electrical Engineering: Kernqualifikation: Compulsory suffrage
Electrical Engineering myTrack: Kernqualifikation: Compulsory suffrage

General Engineering Science (English program): Vertiefung Computer Science and Engineering: Compulsory
General Engineering Science (English program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Biomechanics: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Materials in Engineering Sciences: Compulsory
Computational Science and Engineering: Kernqualifikation: Compulsory
Process Engineering: Vertiefung Process Engineering : Compulsory suffrage

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Course: Numerical Mathematics I (Vorlesung)

Lecturer:
Prof. Sabine Le Borne

Language:
DE

Cycle:
WS

Content:

1. Error analysis: Number representation, error types, conditioning and stability
2. Interpolation: polynomial and spline interpolation
3. Numerical integration and differentiation: order, Newton-Cotes formula, error estimates, Gaussian quadrature, adaptive quadrature, difference formulas
4. Linear systems: LU and Cholesky factorization, matrix norms, conditioning
5. Linear least squares problems: normal equations, Gram.Schmidt and Householder orthogonalization, singular value decomposition, regularization
6. Eigenvalue problems: power iteration, inverse iteration, QR algorithm
7. Nonlinear systems of equations: Fixed point iteration, root-finding algorithms for real-valued functions, Newton and Quasi-Newton methods for systems

Literature:

- Stoer/Bulirsch: Numerische Mathematik 1, Springer
- Dahmen, Reusken: Numerik für Ingenieure und Naturwissenschaftler, Springer

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Course: Numerical Mathematics I (Übung)

Lecturer:
Prof. Sabine Le Borne

Language:
DE

Cycle:
WS

Content:

1. Error analysis: Number representation, error types, conditioning and stability
2. Interpolation: polynomial and spline interpolation
3. Numerical integration and differentiation: order, Newton-Cotes formula, error estimates, Gaussian quadrature, adaptive quadrature, difference formulas
4. Linear systems: LU and Cholesky factorization, matrix norms, conditioning
5. Linear least squares problems: normal equations, Gram.Schmidt and Householder orthogonalization, singular value decomposition, regularization
6. Eigenvalue problems: power iteration, inverse iteration, QR algorithm
7. Nonlinear systems of equations: Fixed point iteration, root-finding algorithms for real-valued functions, Newton and Quasi-Newton methods for systems

Literature:

- Stoer/Bulirsch: Numerische Mathematik 1, Springer
- Dahmen, Reusken: Numerik für Ingenieure und Naturwissenschaftler, Springer

Module: Heat Transfer

Courses:

Title	Typ	Hrs/wk
Heat Transfer	Vorlesung	3
Heat Transfer	Hörsaalübung	1

Module Responsibility:
Prof. Heinz Herwig

Admission Requirements:
none

Recommended Previous Knowledge:
Technical Thermodynamics I, II and Fluid Dynamics

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students are able to
- describe the different physical mechanism of Heat Transfer,
- explain the technical terms,
- to analyse comlex heat transfer processes in a critical way.

Capabilities:
The students are able to
- understand the physics of Heat Transfer,
- calculate and evaluate complex Heat Transfer processes,
- solve excersises self-consistent and in small groups.

Personal Competence:
Social Competence:
The students are able to discuss in small groups and develop an approach.
Autonomy:
The students are able to develop a complex problem self-consistent and analyse the results in a critical way. A qualified exchange with other students is given.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Biomechanics: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Energy Systems: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Theoretical Mechanical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Biomechanics: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Energy Systems: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Theoretical Mechanical Engineering: Compulsory
Mechanical Engineering: Vertiefung Energy Systems: Compulsory
Mechanical Engineering: Vertiefung Theoretical Mechanical Engineering: Compulsory

Course: Heat Transfer (Vorlesung)

Lecturer:
Prof. Heinz Herwig

Language:
DE

Cycle:
WS

Content:
Dimensional analysis, heat conduction, convective heat transfer, Two- phase heat transfer (evaporation, condensation), thermal radiation, heat exchangers, measurement methods

Literature:

- Herwig, H.; Moschallski, A.: Wärmeübertragung, 2. Auflage, Vieweg+Teubner Verlag, Wiesbaden, 2009
- Herwig, H.: Wärmeübertragung von A-Z, Springer- Verlag, Berlin, Heidelberg, 2000
- Baehr, H.D.; Stephan, K.: Wärme- und Stoffübertragung, 2. Auflage, Springer Verlag, Berlin, Heidelberg, 1996

Course: Heat Transfer (Übung)

Lecturer:

Prof. Heinz Herwig

Language:

DE

Cycle:

WS

Content:

Dimensional analysis, heat conduction, convective heat transfer, Two- phase heat transfer (evaporation, condensation), thermal radiation, heat exchangers, measurement methods

Literature:

- Herwig, H.; Moschallski, A.: Wärmeübertragung, 2. Auflage, Vieweg+Teubner Verlag, Wiesbaden, 2009
- Herwig, H.: Wärmeübertragung von A-Z, Springer- Verlag, Berlin, Heidelberg, 2000
- Baehr, H.D.; Stephan, K.: Wärme- und Stoffübertragung, 2. Auflage, Springer Verlag, Berlin, Heidelberg, 1996

Focus Energy Systems

Module: Advanced Mechanical Engineering Design

Courses:

Title	Typ	Hrs/wk
Advanced Mechanical Engineering Design II	Vorlesung	2
Advanced Mechanical Engineering Design II	Hörsaalübung	2
Advanced Mechanical Engineering Design I	Vorlesung	2
Advanced Mechanical Engineering Design I	Hörsaalübung	2

Module Responsibility:
Prof. Dieter Krause

Admission Requirements:
None

Recommended Previous Knowledge:

- Fundamentals of Mechanical Engineering Design
- Mechanics
- Fundamentals of Materials Science
- Production Engineering

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
After passing the module, students are able to:

- explain complex working principles and functions of machine elements and of basic elements of fluidics,
- explain requirements, selection criteria, application scenarios and practical examples of complex machine elements,
- indicate the background of dimensioning calculations.

Capabilities:
After passing the module, students are able to:

- accomplish dimensioning calculations of covered machine elements,
- transfer knowledge learned in the module to new requirements and tasks (problem solving skills),
- recognize the content of technical drawings and schematic sketches,
- evaluate complex designs, technically.

Personal Competence:
Social Competence:

- Students are able to discuss technical information in the lecture supported by activating methods.

Autonomy:

- Students are able to independently deepen their acquired knowledge in exercises.
- Students are able to acquire additional knowledge and to recapitulate poorly understood content e.g. by using the video recordings of the lectures.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 68, Study Time in Lecture: 112

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Energy Systems: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Aircraft Systems Engineering: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Materials in Engineering Sciences: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Mechatronics: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Product Development and Production: Compulsory

General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Theoretical Mechanical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Energy Systems: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Aircraft Systems Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Materials in Engineering Sciences: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Mechatronics: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Product Development and Production: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Theoretical Mechanical Engineering: Compulsory
Mechanical Engineering: Kernqualifikation: Compulsory
Naval Architecture: Kernqualifikation: Compulsory

Course: Advanced Mechanical Engineering Design II (Vorlesung)

Lecturer:
Prof. Dieter Krause, Prof. Otto von Estorff

Language:
DE

Cycle:
SS

Content:
Advanced Mechanical Engineering Design I & II
Lecture

- Fundamentals of the following machine elements:
  - Linear rolling bearings
  - Axes & shafts
  - Seals
  - Clutches & brakes
  - Belt & chain drives
  - Gear drives
  - Epicyclic gears
  - Crank drives
  - Sliding bearings
- Elements of fluidics

Exercise

- Calculation methods of the following machine elements:
  - Linear rolling bearings
  - Axes & shafts
  - Clutches & brakes
  - Belt & chain drives
  - Gear drives
  - Epicyclic gears
  - Crank gears
  - Sliding bearings
- Calculations of hydrostatic systems (fluidics)

Literature:

- Dubbel, Taschenbuch für den Maschinenbau; Grote, K.-H., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.
- Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.
- Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.
- Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.
- Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.
- Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.
- Maschinenelemente – Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.
- Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.

Sowie weitere Bücher zu speziellen Themen

Course: Advanced Mechanical Engineering Design II (Übung)

Lecturer:
Prof. Dieter Krause, Prof. Otto von Estorff

Language:
DE

Cycle:
SS

Content:
Advanced Mechanical Engineering Design I & II
Lecture

- Fundamentals of the following machine elements:
  - Linear rolling bearings
  - Axes & shafts
  - Seals
  - Clutches & brakes
  - Belt & chain drives
  - Gear drives
  - Epicyclic gears
  - Crank drives
  - Sliding bearings
- Elements of fluidics

Exercise

- Calculation methods of the following machine elements:
  - Linear rolling bearings
  - Axes & shafts
  - Clutches & brakes
  - Belt & chain drives
  - Gear drives
  - Epicyclic gears
  - Crank gears
  - Sliding bearings
- Calculations of hydrostatic systems (fluidics)

Literature:

- Dubbel, Taschenbuch für den Maschinenbau; Grote, K.-H., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.
- Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.
- Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.
- Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.
- Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.
- Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.
- Maschinenelemente – Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.
- Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.

Sowie weitere Bücher zu speziellen Themen

Course: Advanced Mechanical Engineering Design I (Vorlesung)

Lecturer:
Prof. Dieter Krause, Prof. Otto von Estorff

Language:
DE

Cycle:
WS

Content:
Advanced Mechanical Engineering Design I & II
Lecture

- Fundamentals of the following machine elements:
  - Linear rolling bearings
  - Axes & shafts
  - Seals
  - Clutches & brakes
  - Belt & chain drives
  - Gear drives
  - Epicyclic gears
  - Crank drives
  - Sliding bearings
- Elements of fluidics

Exercise

- Calculation methods of the following machine elements:

  - Linear rolling bearings
  - Axes & shafts
  - Clutches & brakes
  - Belt & chain drives
  - Gear drives
  - Epicyclic gears
  - Crank gears
  - Sliding bearings
- Calculations of hydrostatic systems (fluidics)

Literature:

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- Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.
- Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.
- Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.
- Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.
- Maschinenelemente – Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.
- Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.

Sowie weitere Bücher zu speziellen Themen

Course: Advanced Mechanical Engineering Design I (Übung)

Lecturer:
Prof. Dieter Krause, Prof. Otto von Estorff

Language:
DE

Cycle:
WS

Content:
Advanced Mechanical Engineering Design I & II
Lecture

- Fundamentals of the following machine elements:
  - Linear rolling bearings
  - Axes & shafts
  - Seals
  - Clutches & brakes
  - Belt & chain drives
  - Gear drives
  - Epicyclic gears
  - Crank drives
  - Sliding bearings
- Elements of fluidics

Exercise

- Calculation methods of the following machine elements:
  - Linear rolling bearings
  - Axes & shafts
  - Clutches & brakes
  - Belt & chain drives
  - Gear drives
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- Dubbel, Taschenbuch für den Maschinenbau; Grote, K.-H., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.
- Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.
- Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.
- Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.
- Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.
- Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.
- Maschinenelemente – Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.
- Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.

Sowie weitere Bücher zu speziellen Themen

Module: Gas and Steam Power Plants

Courses:

Title	Typ	Hrs/wk
Gas and Steam Power Plants	Vorlesung	3
Gas and Steam Power Plants	Hörsaalübung	2

Module Responsibility:
Prof. Alfons Kather

Admission Requirements:

- "Technical Thermodynamics I and II"
- "Heat Transfer"
- "Fluid Mechanics"

Recommended Previous Knowledge:
Knowledge in Thermodynamics incl. Combustion Calculations, Heat Transfer and Fluid Mechanics

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students can evaluate the development of the electricity demand and the energy conversion routes in the thermal power plant, describe the various types of power plant and the layout of the steam generatorblock and determine the operation characteristics of the power plant. Additionally they can describe the exhaust gas cleaning apparatus and the combination possibilities of conventional fossil-fuelled power plants with solar thermal and geothermal power plants or plants equipped with Carbon Capture and Storage.
Capabilities:
The students will be able, using theories and methods of the energy technology from fossil fuels and based on deep knowledge on the function and construction of gas and steam power plants, to identify basic associations in the production of heat and electricity, so as to develop conceptional solutions. Through analysis of the problem and exposure to the inherent interconnections between heat and power generation, will endow the students with the capability and methodology to develop realistic optimal concepts for the generation of electricity and the production of heat. From the technical basics the students become the ability to follow better the deliberations on the electricity mix composition within the energy-political triangle (economy, secure supply and environmental protection).
Within the framework of the exercise the students learn the use of the specialised software suite EBSILON Professional^{TM}. With this tool small tasks are solved on the PC, to highlight aspects of the design and development of power plant cycles.

Personal Competence:
Social Competence:
A multi-day excursion within the framework of the lecture is planned for those students that are interested. The students thus get direct contact with the whole subject field of gas and steam power plants. Through discussions with the plant personnel the students are able to obtain an overview on daily operation problems and their solution approach.

Autonomy:
The students assisted by the tutors will be able to develop alone simple simulation models and run with these scenario analyses. In this manner the theoretical and practical knowledge from the lecture is consolidated and the potential effects from different process combinations and boundary conditions highlighted. The students are able independently to analyse the operational performance of steam power plants and calculate selected quantities and characteristc curves.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 110, Study Time in Lecture: 70

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Energy Systems: Compulsory
Energy and Environmental Engineering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Energy Systems: Compulsory
Mechanical Engineering: Vertiefung Energy Systems: Compulsory

Course: Gas and Steam Power Plants (Vorlesung)

Lecturer:

Prof. Alfons Kather

Language:
DE

Cycle:
WS

Content:
In the 1st part of the lecture an overview on thermal power plants is offered, including:

- Electricity demand and Forecasting
- Thermodynamic fundamentals
- Energy Conversion in thermal power plants
- Types of power plant
- Layout of the power plant block
- Individual elements of the power plant
- Cooling systems
- Flue gas cleaning
- Operation characteristics of the power plant
- Construction materials for power plants
- Location of power plants
- Solar shermal plants/geothermal plants/Carbon Capture and Storage plants

These are complemented in the 2nd part of the module by the more specialised issues:

- Energy balance of a fluid-flow machine
- Theory of turbine and compressor stage
- Equal and positive pressure blading
- Flow losses
- Characteristic numbers
- Axial and radial design
- Design features
- Hydraulic fluid-flow machines
- Pump and water turbine designs
- Design examples of reciprocating engines and turbomachinery
- Steam power plants
- Gas turbine systems

Literature:

- Kalide: Kraft- und Arbeitsmaschinen
- Thomas, H.J.: Thermische Kraftanlagen. Springer-Verlag, 1985
- Strauß, K.: Kraftwerkstechnik. Springer-Verlag, 2006
- Kugeler und Phlippen: Energietechnik. Springer-Verlag, 1990
- T. Bohn (Hrsg.): Handbuchreihe Energie, Band 7: Gasturbinenkraftwerke, Kombikraftwerke, Heizkraftwerke und Industriekraftwerke, Technischer Verlag Resch / Verlag TÜV Rheinland

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Course: Gas and Steam Power Plants (Übung)

Lecturer:
Prof. Alfons Kather

Language:
DE

Cycle:
WS

Content:
In the 1st part of the lecture a general introduction into fluid-flow machines and steam power plants is offered, including:

- Energy balance of a fluid-flow machine
- Theory of turbine and compressor stage
- Equal and positive pressure blading
- Flow losses
- Characteristic numbers
- Axial and radial design
- Design features
- Hydraulic fluid-flow machines
- Pump and water turbine designs
- Design examples of reciprocating engines and turbomachinery
- Steam power plants

- Gas turbine systems
- Diesel engine systems
- Waste heat utilisation

followed by the more specialised issues:

- Electricity Demand and Forecasting
- Thermodynamic fundamentals
- Energy Conversion in Thermal Power Plants
- Types of Power Plant
- Layout of the power plant block
- Individual elements of the power plant
- Cooling systems
- Flue gas cleaning
- Operation characteristics of the power plant
- Construction materials
- Location of power plants

Literature:

- Skripte
- Kalide: Kraft- und Arbeitsmaschinen
- Thomas, H.J.: Thermische Kraftanlagen. Springer-Verlag, 1985
- Strauß, K.: Kraftwerkstechnik. Springer-Verlag, 2006
- Kugeler und Phlippen: Energietechnik. Springer-Verlag, 1990
- T. Bohn (Hrsg.): Handbuchreihe Energie, Band 7: Gasturbinenkraftwerke, Kombikraftwerke, Heizkraftwerke und Industriekraftwerke, Technischer Verlag Resch / Verlag TÜV Rheinland

Module: Computational Fluid Dynamics I

Courses:

Title	Typ	Hrs/wk
Computational Fluid Dynamics I	Vorlesung	2
Computational Fluid Dynamics I	Hörsaalübung	2

Module Responsibility:
Prof. Thomas Rung

Admission Requirements:
Mathematical Methods for Engineers

Recommended Previous Knowledge:
Fundamentals of Differential/integral calculus and series expansions.

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students are able to list the basic numerics of partial differential equations.

Capabilities:
The students are able develop appropriate numerical integration in space and time for the governing partial differential equations. They can code computational algorithms in a structured way.

Personal Competence:
Social Competence:
The students can arrive at work results in groups and document them.

Autonomy:
The students can independently analyse approaches to solving specific problems.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Energy Systems: Compulsory
General Engineering Science (German program): Vertiefung Naval Architecture: Compulsory
General Engineering Science (English program): Vertiefung Naval Architecture: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Energy Systems: Compulsory
Computational Science and Engineering: Vertiefung Engineering Sciences: Compulsory suffrage
Naval Architecture: Kernqualifikation: Compulsory
Technomathematics: Vertiefung Engineering Science: Compulsory suffrage

Course: Computational Fluid Dynamics I (Vorlesung)

Lecturer:
Prof. Thomas Rung

Language:
DE

Cycle:
WS

Content:
Fundamentals of computational modelling of thermofluid dynamic problems. Development of numerical algorithms.

1. Partial differential equations
2. Foundations of finite numerical approximations
3. Computation of potential flows
4. Introduction of finite-differences
5. Approximation of convective, diffusive and transient transport processes
6. Formulation of boundary conditions and initial conditions

7. Assembly and solution of algebraic equation systems
8. Facets of weighted -residual approaches
9. Finite volume methods
10. Basics of grid generation

Literature:
Ferziger and Peric: *Computational Methods for Fluid Dynamics*, Springer

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Course: Computational Fluid Dynamics I (Übung)

Lecturer:
Prof. Thomas Rung

Language:
DE

Cycle:
WS

Content:
Fundamentals of computational modelling of thermofluid dynamic problems. Development of numerical algorithms.

1. Partial differential equations
2. Foundations of finite numerical approximations
3. Computation of potential flows
4. Introduction of finite-differences
5. Approximation of convective, diffusive and transient transport processes
6. Formulation of boundary conditions and initial conditions
7. Assembly and solution of algebraic equation systems
8. Facets of weighted -residual approaches
9. Finite volume methods
10. Basics of grid generation

Literature:
Ferziger and Peric: *Computational Methods for Fluid Dynamics*, Springer

Module: Heat Transfer

Courses:

Title	Typ	Hrs/wk
Heat Transfer	Vorlesung	3
Heat Transfer	Hörsaalübung	1

Module Responsibility:
Prof. Heinz Herwig

Admission Requirements:
none

Recommended Previous Knowledge:
Technical Thermodynamics I, II and Fluid Dynamics

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students are able to
- describe the different physical mechanism of Heat Transfer,
- explain the technical terms,
- to analyse comlex heat transfer processes in a critical way.

Capabilities:
The students are able to
- understand the physics of Heat Transfer,
- calculate and evaluate complex Heat Transfer processes,
- solve excersises self-consistent and in small groups.

Personal Competence:
Social Competence:
The students are able to discuss in small groups and develop an approach.
Autonomy:
The students are able to develop a complex problem self-consistent and analyse the results in a critical way. A qualified exchange with other students is given.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Biomechanics: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Energy Systems: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Theoretical Mechanical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Biomechanics: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Energy Systems: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Theoretical Mechanical Engineering: Compulsory
Mechanical Engineering: Vertiefung Energy Systems: Compulsory
Mechanical Engineering: Vertiefung Theoretical Mechanical Engineering: Compulsory

Course: Heat Transfer (Vorlesung)

Lecturer:
Prof. Heinz Herwig

Language:
DE

Cycle:
WS

Content:
Dimensional analysis, heat conduction, convective heat transfer, Two- phase heat transfer (evaporation, condensation), thermal radiation, heat exchangers, measurement methods

Literature:

- Herwig, H.; Moschallski, A.: Wärmeübertragung, 2. Auflage, Vieweg+Teubner Verlag, Wiesbaden, 2009
- Herwig, H.: Wärmeübertragung von A-Z, Springer- Verlag, Berlin, Heidelberg, 2000
- Baehr, H.D.; Stephan, K.: Wärme- und Stoffübertragung, 2. Auflage, Springer Verlag, Berlin, Heidelberg, 1996

Course: Heat Transfer (Übung)

Lecturer:

Prof. Heinz Herwig

Language:

DE

Cycle:

WS

Content:

Dimensional analysis, heat conduction, convective heat transfer, Two- phase heat transfer (evaporation, condensation), thermal radiation, heat exchangers, measurement methods

Literature:

- Herwig, H.; Moschallski, A.: Wärmeübertragung, 2. Auflage, Vieweg+Teubner Verlag, Wiesbaden, 2009
- Herwig, H.: Wärmeübertragung von A-Z, Springer- Verlag, Berlin, Heidelberg, 2000
- Baehr, H.D.; Stephan, K.: Wärme- und Stoffübertragung, 2. Auflage, Springer Verlag, Berlin, Heidelberg, 1996

Module: Reciprocating Machinery

Courses:

Title	Typ	Hrs/wk
Fundamentals of Reciprocating Engines and Turbomachinery - Part Reciprocating Engines	Vorlesung	1
Fundamentals of Reciprocating Engines and Turbomachinery - Part Reciprocating Engines	Hörsaalübung	1
Internal Combustion Engines I	Vorlesung	2
Internal Combustion Engines I	Hörsaalübung	1

Module Responsibility:
Prof. Christopher Friedrich Wirz

Admission Requirements:
None

Recommended Previous Knowledge:
Thermodynamics, Mechanics, Machine Elements

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
As a result of the part module „Fundamentals of Reciprocating Machinery", the students are able to reflect fundamentals regarding power and working machinery and describe the qualitative and quantitative correlations of operating methods and efficiencies of multiple types of engines, compressors and pumps. They are able to utilize technical terms and parameters as well as aspects regarding the development of power density and efficiency, furthermore to give an overview of charging systems, fuels and emissions. The students are able to select specific types of machinery and assess design related and operational problems.
As a result of the part module "Internal Combustion Engines I", the students are able reflect and utilize the state-of-the-art regarding efficiency limits. In addition, they are able to utilize their knowledge of design, mechanical and thermodynamic characteristics and the approach of similarity. They are able to explain, assess and develop engines as well as charging systems. Detailed knowledge is present regarding computer-aided process design.
Capabilities:
The students are skilled to employ basic and detail knowledge regarding reciprocating machinery, their selection and operation. They are further able to assess, analyse and solve technical and operational problems and to perform mechanical and thermodynamic design.

Personal Competence:
Social Competence:
The students are able to communicate and cooperate in a professional environment in the field of machinery design and application.

Autonomy:
The widespread scope of gained knowledge enables the students to handle situations in their future profession independently and confidently.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 110, Study Time in Lecture: 70

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Energy Systems: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Energy Systems: Compulsory
Mechanical Engineering: Vertiefung Energy Systems: Compulsory

Course: Fundamentals of Reciprocating Engines and Turbomachinery - Part Reciprocating Engines (Vorlesung)

Lecturer:
Prof. Christopher Friedrich Wirz

Language:
DE

Cycle:
WS

Content:

Literature:

Course: Fundamentals of Reciprocating Engines and Turbomachinery - Part Reciprocating Engines (Übung)

Lecturer:
Prof. Christopher Friedrich Wirz

Language:
DE

Cycle:
WS

Content:

Literature:

Course: Internal Combustion Engines I (Vorlesung)

Lecturer:
Prof. Wolfgang Thiemann

Language:
DE

Cycle:
SS

Content:

- The beginnings of engine development
- Design of of motors
- Real process calculation
- Charging methods
- Kinematics of the crank mechanism
- Forces in the engine

Literature:

- Vorlesungsskript
- Übungsaufgaben mit Lösungsweg
- Literaturliste

Course: Internal Combustion Engines I (Übung)

Lecturer:
Prof. Wolfgang Thiemann

Language:
DE

Cycle:
SS

Content:
Calculation of tasks to:

- Design of of motors
- Real process calculation
- Charging methods
- Kinematics of the crank mechanism
- Forces in the engine

Literature:
Vorlesungsskript

Module: Advanced Mechanical Engineering Design

Courses:

Title	Typ	Hrs/wk
Advanced Mechanical Engineering Design II	Vorlesung	2
Advanced Mechanical Engineering Design II	Hörsaalübung	2
Advanced Mechanical Engineering Design I	Vorlesung	2
Advanced Mechanical Engineering Design I	Hörsaalübung	2

Module Responsibility:
Prof. Dieter Krause

Admission Requirements:
None

Recommended Previous Knowledge:

- Fundamentals of Mechanical Engineering Design
- Mechanics
- Fundamentals of Materials Science
- Production Engineering

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
After passing the module, students are able to:

- explain complex working principles and functions of machine elements and of basic elements of fluidics,
- explain requirements, selection criteria, application scenarios and practical examples of complex machine elements,
- indicate the background of dimensioning calculations.

Capabilities:
After passing the module, students are able to:

- accomplish dimensioning calculations of covered machine elements,
- transfer knowledge learned in the module to new requirements and tasks (problem solving skills),
- recognize the content of technical drawings and schematic sketches,
- evaluate complex designs, technically.

Personal Competence:
Social Competence:

- Students are able to discuss technical information in the lecture supported by activating methods.

Autonomy:

- Students are able to independently deepen their acquired knowledge in exercises.
- Students are able to acquire additional knowledge and to recapitulate poorly understood content e.g. by using the video recordings of the lectures.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 68, Study Time in Lecture: 112

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Energy Systems: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Aircraft Systems Engineering: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Materials in Engineering Sciences: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Mechatronics: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Product Development and Production: Compulsory

General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Theoretical Mechanical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Energy Systems: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Aircraft Systems Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Materials in Engineering Sciences: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Mechatronics: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Product Development and Production: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Theoretical Mechanical Engineering: Compulsory
Mechanical Engineering: Kernqualifikation: Compulsory
Naval Architecture: Kernqualifikation: Compulsory

Course: Advanced Mechanical Engineering Design II (Vorlesung)

Lecturer:
Prof. Dieter Krause, Prof. Otto von Estorff

Language:
DE

Cycle:
SS

Content:
Advanced Mechanical Engineering Design I & II
Lecture

- Fundamentals of the following machine elements:
  - Linear rolling bearings
  - Axes & shafts
  - Seals
  - Clutches & brakes
  - Belt & chain drives
  - Gear drives
  - Epicyclic gears
  - Crank drives
  - Sliding bearings
- Elements of fluidics

Exercise

- Calculation methods of the following machine elements:
  - Linear rolling bearings
  - Axes & shafts
  - Clutches & brakes
  - Belt & chain drives
  - Gear drives
  - Epicyclic gears
  - Crank gears
  - Sliding bearings
- Calculations of hydrostatic systems (fluidics)

Literature:

- Dubbel, Taschenbuch für den Maschinenbau; Grote, K.-H., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.
- Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.
- Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.
- Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.
- Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.
- Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.
- Maschinenelemente – Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.
- Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.

Sowie weitere Bücher zu speziellen Themen

Course: Advanced Mechanical Engineering Design II (Übung)

Lecturer:
Prof. Dieter Krause, Prof. Otto von Estorff

Language:
DE

Cycle:
SS

Content:
Advanced Mechanical Engineering Design I & II
Lecture

- Fundamentals of the following machine elements:
  - Linear rolling bearings
  - Axes & shafts
  - Seals
  - Clutches & brakes
  - Belt & chain drives
  - Gear drives
  - Epicyclic gears
  - Crank drives
  - Sliding bearings
- Elements of fluidics

Exercise

- Calculation methods of the following machine elements:
  - Linear rolling bearings
  - Axes & shafts
  - Clutches & brakes
  - Belt & chain drives
  - Gear drives
  - Epicyclic gears
  - Crank gears
  - Sliding bearings
- Calculations of hydrostatic systems (fluidics)

Literature:

- Dubbel, Taschenbuch für den Maschinenbau; Grote, K.-H., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.
- Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.
- Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.
- Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.
- Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.
- Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.
- Maschinenelemente – Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.
- Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.

Sowie weitere Bücher zu speziellen Themen

Course: Advanced Mechanical Engineering Design I (Vorlesung)

Lecturer:
Prof. Dieter Krause, Prof. Otto von Estorff

Language:
DE

Cycle:
WS

Content:
Advanced Mechanical Engineering Design I & II
Lecture

- Fundamentals of the following machine elements:
  - Linear rolling bearings
  - Axes & shafts
  - Seals
  - Clutches & brakes
  - Belt & chain drives
  - Gear drives
  - Epicyclic gears
  - Crank drives
  - Sliding bearings
- Elements of fluidics

Exercise

- Calculation methods of the following machine elements:

  - Linear rolling bearings
  - Axes & shafts
  - Clutches & brakes
  - Belt & chain drives
  - Gear drives
  - Epicyclic gears
  - Crank gears
  - Sliding bearings
- Calculations of hydrostatic systems (fluidics)

Literature:

- Dubbel, Taschenbuch für den Maschinenbau; Grote, K.-H., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.
- Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.
- Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.
- Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.
- Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.
- Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.
- Maschinenelemente – Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.
- Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.

Sowie weitere Bücher zu speziellen Themen

Course: Advanced Mechanical Engineering Design I (Übung)

Lecturer:
Prof. Dieter Krause, Prof. Otto von Estorff

Language:
DE

Cycle:
WS

Content:
Advanced Mechanical Engineering Design I & II
Lecture

- Fundamentals of the following machine elements:
  - Linear rolling bearings
  - Axes & shafts
  - Seals
  - Clutches & brakes
  - Belt & chain drives
  - Gear drives
  - Epicyclic gears
  - Crank drives
  - Sliding bearings
- Elements of fluidics

Exercise

- Calculation methods of the following machine elements:
  - Linear rolling bearings
  - Axes & shafts
  - Clutches & brakes
  - Belt & chain drives
  - Gear drives
  - Epicyclic gears
  - Crank gears
  - Sliding bearings
- Calculations of hydrostatic systems (fluidics)

Literature:

- Dubbel, Taschenbuch für den Maschinenbau; Grote, K.-H., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.
- Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.
- Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.
- Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.
- Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.
- Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.
- Maschinenelemente – Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.
- Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.

Sowie weitere Bücher zu speziellen Themen

Courses:

Title	Typ	Hrs/wk
Simulation of Dynamic Systems	Vorlesung	2
Simulation of Dynamic Systems	Gruppenübung	1
Reliability of Dynamic Systems	Vorlesung	2
Reliability of Dynamic Systems	Gruppenübung	1

Module Responsibility:
Prof. Uwe Weltin

Admission Requirements:

Recommended Previous Knowledge:
Fundatmentals of mechanics, control theory and electrical engineering

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students are able to describe methods and calculations for modeling, simulation and optimization of complex mechanical systems.
Capabilities:
Students are able to apply modern algorithms for modeling of mechanical systems.

Personal Competence:
Social Competence:
Students are able to work goal-oriented in small mixed groups.
Autonomy:
Students are able to recognize and improve knowledge deficits independently.
With instructor assistance, students are able to evaluate their own knowledge level and define a further course of study.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 96, Study Time in Lecture: 84

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Aircraft Systems Engineering: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Mechatronics: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Theoretical Mechanical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Aircraft Systems Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Mechatronics: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Theoretical Mechanical Engineering: Compulsory
Mechanical Engineering: Vertiefung Aircraft Systems Engineering: Compulsory
Mechanical Engineering: Vertiefung Theoretical Mechanical Engineering: Compulsory
Mechanical Engineering: Vertiefung Mechatronics: Compulsory
Mechatronics: Kernqualifikation: Compulsory

Course: Simulation of Dynamic Systems (Vorlesung)

Lecturer:
Prof. Uwe Weltin

Language:
DE

Cycle:
WS

Content:
Modeling
Model Identifikation
Numerical Methods in simulation
Applications and examples in Matlab® and Simulink®

Literature:
Skript zur Veranstaltung
Weitere Literatur in der Veranstaltung

Course: Simulation of Dynamic Systems (Übung)

Lecturer:
Prof. Uwe Weltin

Language:
DE

Cycle:
WS

Content:
Modeling
Model Identifikation
Numerical Methods in simulation
Applications and examples in Matlab® and Simulink®

Literature:
Skript zur Veranstaltung
Weitere Literatur in der Veranstaltung

Course: Reliability of Dynamic Systems (Vorlesung)

Lecturer:
Prof. Uwe Weltin

Language:
DE

Cycle:
WS

Content:
Methods for prediction and validation of life cycle of components and systems
Modeling, simulation, parameter identificaiton
Load data analysis and damage accumulation
Fatigue testing

Literature:
Bertsche, B.: Reliability in Automotive and Mechanical Engineering. Springer, 2008. ISBN: 978-3-540-33969-4
Inman, Daniel J.: Engineering Vibration. Prentice Hall, 3rd Ed., 2007. ISBN-13: 978-0132281737
Dresig, H., Holzweißig, F.: Maschinendynamik, Springer Verlag, 9. Auflage, 2009. ISBN 3540876936.
VDA (Hg.): Zuverlässigkeitssicherung bei Automobilherstellern und Lieferanten. Band 3 Teil 2, 3. überarbeitete Auflage, 2004. ISSN 0943-9412

Course: Reliability of Dynamic Systems (Übung)

Lecturer:
Prof. Uwe Weltin

Language:
DE

Cycle:
WS

Content:
Methods for prediction and validation of life cycle of components and systems
Modeling, simulation, parameter identificaiton
Load data analysis and damage accumulation
Fatigue testing

Literature:
Bertsche, B.: Reliability in Automotive and Mechanical Engineering. Springer, 2008. ISBN: 978-3-540-33969-4
Inman, Daniel J.: Engineering Vibration. Prentice Hall, 3rd Ed., 2007. ISBN-13: 978-0132281737
Dresig, H., Holzweißig, F.: Maschinendynamik, Springer Verlag, 9. Auflage, 2009. ISBN 3540876936.
VDA (Hg.): Zuverlässigkeitssicherung bei Automobilherstellern und Lieferanten. Band 3 Teil 2, 3. überarbeitete Auflage, 2004. ISSN 0943-9412

Courses:

Title	Typ	Hrs/wk
Advanced Mechanical Design Project	Testat	4

Module Responsibility:
Prof. Dieter Krause

Admission Requirements:
None

Recommended Previous Knowledge:

- Mechanical Engineering: Design
- Advanced Mechanical Engineering Design

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
After passing the module, students are able to:

- express the procedure for systematically handling of
- complex design tasks ,
- describe working principles, their use and combination possibilities,
- explain guidelines for designing for function and manufacturing,
- explain advanced use-oriented knowledge of machine elements.

Capabilities:
After passing the module, students are able to:

- analyze complex tasks and develop principle solutions using sketches,
- convert principle solutions into a detailed design,
- use methods to design and solve engineering design tasks systematically and solution-oriented,
- create a technical documentation including all necessary technical drawings to understand the functions of the system,
- document calculations of selected machine elements clearly and in detail.

Personal Competence:
Social Competence:
After passing the module, students are able to:

- present and discuss solutions and technical drawings within groups,
- reflect the own results in the work groups of the course

Autonomy:
After passing the module, students are able to:

- independently solve complex design projects, while motivating themselves, acquiring necessary knowledge and selecting appropriate methods,
- to independently solve problems.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Aircraft Systems Engineering: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Product Development and Production: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Theoretical Mechanical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Aircraft Systems Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Product Development and Production: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Theoretical Mechanical Engineering: Compulsory

Course: Advanced Mechanical Design Project (Testat)

Lecturer:
Prof. Dieter Krause, Prof. Otto von Estorff, Dr. Jens Schmidt, Dr. Volkert Wollesen

Language:
DE

Cycle:
WS

Content:
Das Konstruktionsprojekt gliedert sich in den Entwurf eines Getriebes sowie die Lösungsfindung.

- Getriebekonstruktion in Einzelarbeit
  - Erarbeitung von Lösungsprinzipien
  - Berechnung von Maschinenelementen
  - Entwurf eines Getriebes im Hauptschnitt plus allen Außenansichten
  - Erstellung einer ausführlichen Dokumentation
- Lösungsfindung
  - Methodische Erarbeitung von prinzipiellen Lösungskonzepten
  - Erstellen einer Dokumentation

Literature:

- Dubbel, Taschenbuch für den Maschinenbau; Grote, K.-H., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.
- Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.
- Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.
- Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.
- Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.
- Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.
- Maschinenelemente – Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.
- Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.
- Sowie weitere Bücher zu speziellen Themen

Courses:

Title	Typ	Hrs/wk
CAE-Team Project	Problemorientierte Lehrveranstaltung	2
Development of Lightweight Design Products	Vorlesung	2
Integrated Product Development I	Vorlesung	2

Module Responsibility:
Prof. Dieter Krause

Admission Requirements:

Recommended Previous Knowledge:
Advanced Knowledge about engineering design:
Fundamentals of Mechanical Engineering Design
Mechanical Engineering: Design
Advanced Mechanical Engineering Design

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
After completing the module, students are capable of:

- explaining the functional principle of 3D-CAD-Systems, PDM- and FEM-Systems
- describing the interaction of the different CAE-Systems in the product development process

Capabilities:

After completing the module, students are able to:

- evaluate different CAD- and PDM-Systems with regards to the desired requirements such as classification schemes and product structuring
- design an exemplary product using CAD-,PDM- and/or FEM-Systems with shared workload

Personal Competence:
Social Competence:
After completing the module, students are able to:

- To develop a project plan and allocate work appropriate work packages in the framework of group discussions
- Present project results as a team for instance in a presentation

Autonomy:
Students are capable of:

- independently adapt to a CAE-Tool and complete a given practical task with it

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 96, Study Time in Lecture: 84

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Aircraft Systems Engineering: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Product Development and Production: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Aircraft Systems Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Product Development and Production: Compulsory
Mechanical Engineering: Vertiefung Product Development and Production: Compulsory
Mechanical Engineering: Vertiefung Aircraft Systems Engineering: Compulsory

Course: CAE-Team Project (Problemorientierte Lehrveranstaltung)

Lecturer:
Prof. Dieter Krause

Language:
DE

Cycle:
SS

Content:

- Practical Introduction in the used software systems (Creo, Windchill, Hyperworks)
- Team formation, allocation of tasks and generation of a project plan
- Collective creation of one product out of CAD models supported by FEM calculations and PDM system
- Manufacturing of selected parts using 3D printer
- Presentation of results

Description
Part of the module is a project based team orientated practical course using the PBL method. In this course, students learn the handling of modern CAD, PDM and FEM systems (Creo, Windchill and Hyperworks). After a short introduction in the applied software systems, students work in teams on a task during the semester. The aim is the development of one product out of several CAD parts models using a PDM system including FEM calculations of selected parts and 3D printing of parts. The developed product must be presented in a joint presentation.

Literature:
-

Course: Development of Lightweight Design Products (Vorlesung)

Lecturer:
Prof. Dieter Krause

Language:
DE

Cycle:
SS

Content:

- Lightweight design materials
- Product development process for lightweight structures
- Dimensioning of lightweight structures

Literature:

- Schürmann, H., „Konstruieren mit Faser-Kunststoff-Verbunden“, Springer, Berlin, 2005.
- Klein, B., „Leichtbau-Konstruktion", Vieweg & Sohn, Braunschweig, 1989.
- Krause, D., „Leichtbau”, In: Handbuch Konstruktion, Hrsg.: Rieg, F., Steinhilper, R., München, Carl Hanser Verlag, 2012.
- Schulte, K., Fiedler, B., „Structure and Properties of Composite Materials”, Hamburg, TUHH - TuTech Innovation GmbH, 2005.
- Wiedemann, J., „Leichtbau Band 1: Elemente“, Springer, Berlin, Heidelberg, 1986.

Course: Integrated Product Development I (Vorlesung)

Lecturer:
Prof. Dieter Krause

Language:
DE

Cycle:
SS

Content:

- Introduction to Integrated Product Development
- 3D CAD -Systems and CAD interfaces
- Administration of part lists / PDM systems
- PDM in different industries
- Selection of CAD-/PDM Systems
- Simulation
- Construction methods
- Design for X

Literature:

- Ehrlenspiel, K.: Integrierte Produktentwicklung, München, Carl Hanser Verlag
- Lee, K.: Principles of CAD / CAM / CAE Systems, Addison Wesles
- Schichtel, M.: Produktdatenmodellierung in der Praxis, München, Carl Hanser Verlag
- Anderl, R.: CAD Schnittstellen, München, Carl Hanser Verlag
- Spur, G., Krause, F.: Das virtuelle Produkt, München, Carl Hanser Verlag

Module: Aeronautical Systems

Courses:

Title	Typ	Hrs/wk
Fundamentals of Aircraft Systems	Vorlesung	2
Fundamentals of Aircraft Systems	Gruppenübung	1
Air Transportation Systems	Vorlesung	2
Air Transportation Systems	Hörsaalübung	1

Module Responsibility:
Prof. Frank Thielecke

Admission Requirements:
none

Recommended Previous Knowledge:
Basics of mathematics, mechanics and thermodynamics

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students get a basic understanding of the structure and design of an aircraft, as well as an overview of the systems inside an aircraft. In addition, a basic knowledge of the relationchips, the key parameters, roles and ways of working in different subsystems in the air transport is acquired.
Capabilities:
Due to the learned cross-system thinking students can gain a deeper understanding of different system concepts and their technical system implementation. In addition, they can apply the learned methods for the design and assessment of subsystems of the air transportation system in the context of the overall system.

Personal Competence:
Social Competence:
Students are made aware of interdisciplinary communication in groups.
Autonomy:
Students are able to independently analyze different system concepts and their technical implementation as well as to think system oriented.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 96, Study Time in Lecture: 84

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Aircraft Systems Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Aircraft Systems Engineering: Compulsory
Logistics and Mobility: Vertiefung Logistics and Mobility: Compulsory suffrage
Mechanical Engineering: Vertiefung Aircraft Systems Engineering: Compulsory

Course: Fundamentals of Aircraft Systems (Vorlesung)

Lecturer:
Prof. Frank Thielecke

Language:
DE

Cycle:
SS

Content:
- Development of aircrafts, fundamentals of flight physics, propulsion systems, analysis of ranges and loads, aircraft-structures and materials
- Hydraulic and electrical power systems, landing gear systems, flight-control and high-lift systems, air conditioning systems

Literature:
- Shevell, R. S.: Fundamentals of Flight
- TÜV Rheinland: Luftfahrtzeugtechnik in Theorie und Praxis
- Wild: Transport Category Aircraft Systems

Course: Fundamentals of Aircraft Systems (Übung)

Lecturer:
Prof. Frank Thielecke

Language:
DE

Cycle:
SS

Content:
- Development of aircrafts, fundamentals of flight physics, propulsion systems, analysis of ranges and loads, aircraft-structures and materials
- Hydraulic and electrical power systems, landing gear systems, flight-control and high-lift systems, air conditioning systems

Literature:
- Shevell, R. S.: Fundamentals of Flight
- TÜV Rheinland: Luftfahrtzeugtechnik in Theorie und Praxis
- Wild: Transport Category Aircraft Systems

Course: Air Transportation Systems (Vorlesung)

Lecturer:
Prof. Volker Gollnick

Language:
DE

Cycle:
SS

Content:

1. Air transport as part of the global transportation system
2. Legal basis of air transportation
3. Safety and security aspects
4. Aircraft basics
5. The role of the aircraft amnufacturer
6. The role of the aircraft operator
7. Airport operation
8. The principles of air traffic management
9. Environmental aspects of air transportation
10. Future perspectives of air transport

Literature:

1. H. Mensen: "Handbuch der Luftfahrt", Springer-Verlag, 2003
2. K. Hünecke: "Die Technik des modernen Verkehrsflugzeugs", Motorbuch-Verlag, 2000, ISBN 3-613-01895-0
3. I. Moir, A. Seabridge: "Aircraft Systems", AIAA Education Series, 2001, ISBN 1-56347-506-5
4. D.P. Raymer: "Aircraft Design - A Conceptual Approach", AIAA Education Series, 2006, ISBN 1-56347-281-3
5. N. Ashford: "Airport Operations", McGraw-Hill, 1997, ISBN0-07-003077-4
6. P. Maurer: "Luftverkehrsmanagement", Oldenbourg-Verlag, ISBN 3-486-27422-8
7. H. Mensen: "Moderne Flugsicherung", Springer-Verlag, 2004, ISBN 3-540-20581-0

Course: Air Transportation Systems (Übung)

Lecturer:
Prof. Volker Gollnick

Language:
DE

Cycle:
SS

Content:
Practical exercises to understand

- aircraft movement in wind conditions
- aircraft performance analyses
- radio navigation prinicples

Objective: Understanding and application of principle methods to practical aviation problems

Literature:
Hünnecke: Das moderne Verkehrsflugzeug von heute
Flühr: Avionik und Flugsicherungstechnik

Focus Materials in Engineering Sciences

Module: Advanced Mechanical Engineering Design

Courses:

Title	Typ	Hrs/wk
Advanced Mechanical Engineering Design II	Vorlesung	2
Advanced Mechanical Engineering Design II	Hörsaalübung	2
Advanced Mechanical Engineering Design I	Vorlesung	2
Advanced Mechanical Engineering Design I	Hörsaalübung	2

Module Responsibility:
Prof. Dieter Krause

Admission Requirements:
None

Recommended Previous Knowledge:

- Fundamentals of Mechanical Engineering Design
- Mechanics
- Fundamentals of Materials Science
- Production Engineering

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
After passing the module, students are able to:

- explain complex working principles and functions of machine elements and of basic elements of fluidics,
- explain requirements, selection criteria, application scenarios and practical examples of complex machine elements,
- indicate the background of dimensioning calculations.

Capabilities:
After passing the module, students are able to:

- accomplish dimensioning calculations of covered machine elements,
- transfer knowledge learned in the module to new requirements and tasks (problem solving skills),
- recognize the content of technical drawings and schematic sketches,
- evaluate complex designs, technically.

Personal Competence:
Social Competence:

- Students are able to discuss technical information in the lecture supported by activating methods.

Autonomy:

- Students are able to independently deepen their acquired knowledge in exercises.
- Students are able to acquire additional knowledge and to recapitulate poorly understood content e.g. by using the video recordings of the lectures.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 68, Study Time in Lecture: 112

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Energy Systems: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Aircraft Systems Engineering: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Materials in Engineering Sciences: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Mechatronics: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Product Development and Production: Compulsory

General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Theoretical Mechanical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Energy Systems: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Aircraft Systems Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Materials in Engineering Sciences: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Mechatronics: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Product Development and Production: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Theoretical Mechanical Engineering: Compulsory
Mechanical Engineering: Kernqualifikation: Compulsory
Naval Architecture: Kernqualifikation: Compulsory

Course: Advanced Mechanical Engineering Design II (Vorlesung)

Lecturer:
Prof. Dieter Krause, Prof. Otto von Estorff

Language:
DE

Cycle:
SS

Content:
Advanced Mechanical Engineering Design I & II
Lecture

- Fundamentals of the following machine elements:
  - Linear rolling bearings
  - Axes & shafts
  - Seals
  - Clutches & brakes
  - Belt & chain drives
  - Gear drives
  - Epicyclic gears
  - Crank drives
  - Sliding bearings
- Elements of fluidics

Exercise

- Calculation methods of the following machine elements:
  - Linear rolling bearings
  - Axes & shafts
  - Clutches & brakes
  - Belt & chain drives
  - Gear drives
  - Epicyclic gears
  - Crank gears
  - Sliding bearings
- Calculations of hydrostatic systems (fluidics)

Literature:

- Dubbel, Taschenbuch für den Maschinenbau; Grote, K.-H., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.
- Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.
- Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.
- Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.
- Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.
- Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.
- Maschinenelemente – Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.
- Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.

Sowie weitere Bücher zu speziellen Themen

Course: Advanced Mechanical Engineering Design II (Übung)

Lecturer:
Prof. Dieter Krause, Prof. Otto von Estorff

Language:
DE

Cycle:
SS

Content:
Advanced Mechanical Engineering Design I & II
Lecture

- Fundamentals of the following machine elements:
  - Linear rolling bearings
  - Axes & shafts
  - Seals
  - Clutches & brakes
  - Belt & chain drives
  - Gear drives
  - Epicyclic gears
  - Crank drives
  - Sliding bearings
- Elements of fluidics

Exercise

- Calculation methods of the following machine elements:
  - Linear rolling bearings
  - Axes & shafts
  - Clutches & brakes
  - Belt & chain drives
  - Gear drives
  - Epicyclic gears
  - Crank gears
  - Sliding bearings
- Calculations of hydrostatic systems (fluidics)

Literature:

- Dubbel, Taschenbuch für den Maschinenbau; Grote, K.-H., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.
- Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.
- Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.
- Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.
- Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.
- Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.
- Maschinenelemente – Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.
- Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.

Sowie weitere Bücher zu speziellen Themen

Course: Advanced Mechanical Engineering Design I (Vorlesung)

Lecturer:
Prof. Dieter Krause, Prof. Otto von Estorff

Language:
DE

Cycle:
WS

Content:
Advanced Mechanical Engineering Design I & II
Lecture

- Fundamentals of the following machine elements:
  - Linear rolling bearings
  - Axes & shafts
  - Seals
  - Clutches & brakes
  - Belt & chain drives
  - Gear drives
  - Epicyclic gears
  - Crank drives
  - Sliding bearings
- Elements of fluidics

Exercise

- Calculation methods of the following machine elements:

  - Linear rolling bearings
  - Axes & shafts
  - Clutches & brakes
  - Belt & chain drives
  - Gear drives
  - Epicyclic gears
  - Crank gears
  - Sliding bearings
- Calculations of hydrostatic systems (fluidics)

Literature:

- Dubbel, Taschenbuch für den Maschinenbau; Grote, K.-H., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.
- Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.
- Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.
- Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.
- Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.
- Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.
- Maschinenelemente – Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.
- Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.

Sowie weitere Bücher zu speziellen Themen

Course: Advanced Mechanical Engineering Design I (Übung)

Lecturer:
Prof. Dieter Krause, Prof. Otto von Estorff

Language:
DE

Cycle:
WS

Content:
Advanced Mechanical Engineering Design I & II
Lecture

- Fundamentals of the following machine elements:
  - Linear rolling bearings
  - Axes & shafts
  - Seals
  - Clutches & brakes
  - Belt & chain drives
  - Gear drives
  - Epicyclic gears
  - Crank drives
  - Sliding bearings
- Elements of fluidics

Exercise

- Calculation methods of the following machine elements:
  - Linear rolling bearings
  - Axes & shafts
  - Clutches & brakes
  - Belt & chain drives
  - Gear drives
  - Epicyclic gears
  - Crank gears
  - Sliding bearings
- Calculations of hydrostatic systems (fluidics)

Literature:

- Dubbel, Taschenbuch für den Maschinenbau; Grote, K.-H., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.
- Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.
- Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.
- Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.
- Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.
- Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.
- Maschinenelemente – Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.
- Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.

Sowie weitere Bücher zu speziellen Themen

Courses:

Title	Typ	Hrs/wk
Numerical Mathematics I	Vorlesung	2
Numerical Mathematics I	Gruppenübung	2

Module Responsibility:
Prof. Sabine Le Borne

Admission Requirements:

- Mathematik I + II for Engineering Students (german or english)

or

- Analysis & Linear Algebra I + II for Technomathematicians

Recommended Previous Knowledge:

- Lecture material of prerequisite lectures
- basic MATLAB knowledge

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students are able to

- name numerical methods for interpolation, integration, least squares problems, eigenvalue problems, nonlinear root finding problems and to explain their core ideas,
- repeat convergence statements for the numerical methods,
- explain aspects for the practical execution of numerical methods with respect to computational and storage complexitx.

Capabilities:
Students are able to

- implement, apply and compare numerical methods using MATLAB,
- justify the convergence behaviour of numerical methods with respect to the problem and solution algorithm,
- select and execute a suitable solution approach for a given problem.

Personal Competence:
Social Competence:
Students are able to

- work together in heterogeneously composed teams (i.e., teams from different study programs and background knowledge), explain theoretical foundations and support each other with practical aspects regarding the implementation of algorithms.

Autonomy:
Students are capable

- to assess whether the supporting theoretical and practical excercises are better solved individually or in a team,
- to assess their individual progess and, if necessary, to ask questions and seek help.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Computer Science and Engineering: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Biomechanics: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Materials in Engineering Sciences: Compulsory
General Engineering Science (German program): Vertiefung Biomedical Engineering: Compulsory
Bioprocess Engineering: Vertiefung A - General Bioprocess Engineering: Compulsory suffrage
Computer Science: Vertiefung Computational Mathematics: Compulsory suffrage
Electrical Engineering: Kernqualifikation: Compulsory suffrage
Electrical Engineering myTrack: Kernqualifikation: Compulsory suffrage

General Engineering Science (English program): Vertiefung Computer Science and Engineering: Compulsory
General Engineering Science (English program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Biomechanics: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Materials in Engineering Sciences: Compulsory
Computational Science and Engineering: Kernqualifikation: Compulsory
Process Engineering: Vertiefung Process Engineering : Compulsory suffrage

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Course: Numerical Mathematics I (Vorlesung)

Lecturer:
Prof. Sabine Le Borne

Language:
DE

Cycle:
WS

Content:

1. Error analysis: Number representation, error types, conditioning and stability
2. Interpolation: polynomial and spline interpolation
3. Numerical integration and differentiation: order, Newton-Cotes formula, error estimates, Gaussian quadrature, adaptive quadrature, difference formulas
4. Linear systems: LU and Cholesky factorization, matrix norms, conditioning
5. Linear least squares problems: normal equations, Gram.Schmidt and Householder orthogonalization, singular value decomposition, regularization
6. Eigenvalue problems: power iteration, inverse iteration, QR algorithm
7. Nonlinear systems of equations: Fixed point iteration, root-finding algorithms for real-valued functions, Newton and Quasi-Newton methods for systems

Literature:

- Stoer/Bulirsch: Numerische Mathematik 1, Springer
- Dahmen, Reusken: Numerik für Ingenieure und Naturwissenschaftler, Springer

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Course: Numerical Mathematics I (Übung)

Lecturer:
Prof. Sabine Le Borne

Language:
DE

Cycle:
WS

Content:

1. Error analysis: Number representation, error types, conditioning and stability
2. Interpolation: polynomial and spline interpolation
3. Numerical integration and differentiation: order, Newton-Cotes formula, error estimates, Gaussian quadrature, adaptive quadrature, difference formulas
4. Linear systems: LU and Cholesky factorization, matrix norms, conditioning
5. Linear least squares problems: normal equations, Gram.Schmidt and Householder orthogonalization, singular value decomposition, regularization
6. Eigenvalue problems: power iteration, inverse iteration, QR algorithm
7. Nonlinear systems of equations: Fixed point iteration, root-finding algorithms for real-valued functions, Newton and Quasi-Newton methods for systems

Literature:

- Stoer/Bulirsch: Numerische Mathematik 1, Springer
- Dahmen, Reusken: Numerik für Ingenieure und Naturwissenschaftler, Springer

Courses:

Title	Typ	Hrs/wk
Fundamentals of Mechanical Properties of Materials	Vorlesung	2
Welding Technology	Vorlesung	3

Module Responsibility:
Prof. Claus Emmelmann

Admission Requirements:
None

Recommended Previous Knowledge:
Fundamentals of Materials Science

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students get to know the principles that are responsible for the mechanical behaviour of metals. They acquire basic knowlegde in modelling of the materials behaviour. Furthermore, the students learn about the behaviour of metals under static and dynamic loads. The students get to know the most important welding technologies and the corresponding systems. They learn about the influence of welding on the materials and design.
Capabilities:
The students know the mechanical properties of metals and the underlying principles. They are able to name the influencing factors on the welding behaviour of steel materials.
The students are able to select between alloys according to the desired mechaincal properties and welability. They can distinguish between different welding techniques and select the suitable technique and system components for a defined application. They are able to dimension weld joints within design tasks.

Personal Competence:
Social Competence:
none
Autonomy:
none

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 110, Study Time in Lecture: 70

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Materials in Engineering Sciences: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Materials in Engineering Sciences: Compulsory
Mechanical Engineering: Vertiefung Materials in Engineering Sciences: Compulsory

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Course: Fundamentals of Mechanical Properties of Materials (Vorlesung)

Lecturer:
Prof. Norbert Huber, Dr. Erica Lilleodden

Language:
EN

Cycle:
SS

Content:
1. Introduction and overview
2. Bonding and crystallography, stress, strain, linear elasticity
3. Plasticity of metallic materials
4. Dislocations: Structure, stress, strain, strain energy
5. Dislocations: Motion and forces
6. Partial dislocations, dislocation interactions, jogs and kinks
7. Strengthening mechanisms
8. Introduction to modelling of materials behaviour, classification of phenomena

9. Linear and nonlinear elasticity
10. Plasticity, tensile loading, cyclic loading
11. Viscoelasticity, effects of loading history, creep, relaxation
12. Viscoplasticity, overstress, rate sensitivity of metallic materials
13. Identification of material parameters

Literature:

Hull and Bacon: Introduction to Dislocations (1984)
G. Gottstein: Physik. Grundlagen der Materialk. (2001)
N.Huber: Scriptum „Materialtheorie“ Uni Karlsruhe (1998)
P. Haupt: Cont. Mechanics and Theory of Materials (2002)

Course: Welding Technology (Vorlesung)

Lecturer:

Prof. Claus Emmelmann, Prof. Karl-Ulrich Kainer

Language:

DE

Cycle:

WS

Content:

- phase transitions, phase diagrams and thermal activated processes
- fundamentals of steels, heat treatment applications for steels and time temperature transformation diagrams
- properties of weldable carbon and fine grained steels
- properties of weldable low- and high-alloy steels, corrosion resistant steels and high-strength steels
- structure and properties of non-ferrite metals (aluminum, titanium)
- NDT/DT Methods for materials and welds
- gas fusion welding, fundamentals of electric arc welding technologies
- structure and influence parameters for the welded joint
- submerged arc welding/tungsten inert gas welding/inert gas metal arc welding (MIG)/active gas metal arc welding (MAG)/Plasma Welding
- resistance welding/ polymer welding/ hybrid-welding
- deposition welding
- electron beam welding/ laser beam welding
- weld joint designs and declarations
- computation methods for weld joint dimensioning

Literature:

Schulze, G.: Die Metallurgie des Schweißens, 4. Aufl., Berlin 2010 Strassburg, F.W. und Wehner H.: Schweißen nichtrostender Stähle, 4. Aufl. Düsseldorf, 2009 Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 1: Schweiß- und Schneidtechnologien, 3. Aufl., Berlin 2006.
Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 2: Verhalten der Werkstoffe beim Schweißen, 3. Aufl., Berlin 2005.
Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 3: Gestaltung und Festigkeit von Schweißkonstruktionen, 2. Aufl., Berlin 2002.

Module: Material Science Laboratory

Courses:

Title	Typ	Hrs/wk
Companion Lecture for Materials Science Laboratory	Vorlesung	2
Material Science Laboratory	Laborpraktikum	4

Module Responsibility:
Prof. Bodo Fiedler

Admission Requirements:
none

Recommended Previous Knowledge:
none

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students are able to give a summary of the technical details of experiments in the area of materials sciences and illustrate respective relationships. They are capable of describing and communicating relevant problems and questions using appropriate technical language. They can explain the typical process of solving practical problems and present related results.
Capabilities:
The students can transfer their fundamental knowledge on material sciences to the process of solving practical problems. They identify and overcome typical problems during the realization of experiments in the context of material sciences.

Personal Competence:
Social Competence:
Students are able to cooperate in small groups in order to conduct experiments in the context of materials sciences. They are able to effectively present and explain their results alone or in groups in front of a qualified audience.
Autonomy:
Students are capable of solving problems in the context of materials sciences using provided literature. They are able to fill gaps in as well as extent their knowledge using the literature and other sources provided by the supervisor.

ECTS-Credit points:
6 LP

Examination:
Kolloquium

Workload in Hours:
Indipendent Study Time: 96, Study Time in Lecture: 84

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Materials in Engineering Sciences: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Product Development and Production: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Materials in Engineering Sciences: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Product Development and Production: Compulsory
Mechanical Engineering: Vertiefung Product Development and Production: Compulsory
Mechanical Engineering: Vertiefung Materials in Engineering Sciences: Compulsory

Course: Companion Lecture for Materials Science Laboratory (Vorlesung)

Lecturer:
Prof. Patrick Huber

Language:
DE

Cycle:
WS

Content:
Physico-chemical backgrounds and fundamental experimental principles with regard to the following experiments, the topics to be addressed are indicated in brackets for each experiment:
1. Phase diagrams, heat treatment, hardness measurements (thermodynamics, elastic properties of solids)
2. notch impact test (elastic properties of solids)
3. Processes during the solidifaction of metals (thermodynamics and kinetics of solid-liquid phase transitions)
4. tensile test (elastic properties of solids)

5. Identificiation of polymers (polymer physics)
6. fiber-reinforced polymers (physical principles of composite materials)
7. Production and microstructure of ceramic materials (physico-chemical principles of ceramics)
8. Mechanical properties of ceramic materials (elastic properties of solids and composite materials)

Literature:

William D. Callister und David G. Rethwisch, Materialwissenschaften und Werkstofftechnik, Wiley&Sons, Asia (2011)
William D. Callister, Materials Science and Technology, Wiley& Sons, Inc. (2007)

Course: Material Science Laboratory (Laborpraktikum)

Lecturer:

Prof. Bodo Fiedler, Prof. Stefan Müller, Prof. Patrick Huber, Prof. Gerold Schneider, Prof. Jörg Weißmüller

Language:

DE

Cycle:

WS

Content:

8 Versuche:
Zustandsdiagramm, Wärmebehandlung, Härtemessung
Kerbschlagbiegeversuch
Vorgänge bei der Erstarrung von Metallen
Zugversuch
Identifizierung von Kunststoffen
Faserverstärkte Kunststoffe
Herstellung und Gefüge keramischer Werkstoffe
Mechanisches Verhalten keramischer Werkstoffe

Literature:

Vorlesungsunterlagen Grundlagen der Werkstoffwissenschaft I & II

Module: Enhanced Fundamentals of Materials Science

Courses:

Title	Typ	Hrs/wk
Fundamentals of Metallic Materials	Vorlesung	2
Fundamentals of Ceramic and Polymer Materials	Vorlesung	2
Fundamentals of Ceramic and Polymer Materials	Hörsaalübung	1

Module Responsibility:
Prof. Gerold Schneider

Admission Requirements:
None

Recommended Previous Knowledge:
Module "Fundamentals of Materials Science"
Module "Materials Science Laboratory"

Module "Advanced Materials"

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students are able to give an enhanced overview over the following topics
in metals, polymers and ceramics: Atomic bonds, crystal and amorphous structures, defects , electrical and mass transport, microstructure and phase diagrams. They are capable to explain the corresponding technical terms.

Capabilities:
The students are able to apply the appropriate physical and chemical methods for the above mentioned subjects.

Personal Competence:
Social Competence:
Autonomy:
The students are capable to understand independently the structure and propeties of ceramics, metals and polymers. They should be able to critally evaluate the profoundness of their knowledge.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 110, Study Time in Lecture: 70

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Materials in Engineering Sciences: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Materials in Engineering Sciences: Compulsory
Mechanical Engineering: Vertiefung Materials in Engineering Sciences: Compulsory
Technomathematics: Kernqualifikation: Compulsory suffrage

Course: Fundamentals of Metallic Materials (Vorlesung)

Lecturer:
Prof. Jörg Weißmüller, Prof. Patrick Huber

Language:
DE

Cycle:
SS

Content:

Literature:
Vorlesungsskript
W.D. Callister: Materials Science and Engineering - An Introduction. 5th ed., John Wiley & Sons, Inc., New York, 2000, ISBN 0-471-32013-7

Course: Fundamentals of Ceramic and Polymer Materials (Vorlesung)

Lecturer:
Prof. Gerold Schneider, Prof. Bodo Fiedler

Language:
DE/EN

Cycle:
SS

Content:

Literature:

Course: Fundamentals of Ceramic and Polymer Materials (Übung)

Lecturer:
Prof. Gerold Schneider, Prof. Bodo Fiedler

Language:
DE/EN

Cycle:
SS

Content:

Literature:

Focus Mechatronics

Module: Advanced Mechanical Engineering Design

Courses:

Title	Typ	Hrs/wk
Advanced Mechanical Engineering Design II	Vorlesung	2
Advanced Mechanical Engineering Design II	Hörsaalübung	2
Advanced Mechanical Engineering Design I	Vorlesung	2
Advanced Mechanical Engineering Design I	Hörsaalübung	2

Module Responsibility:
Prof. Dieter Krause

Admission Requirements:
None

Recommended Previous Knowledge:

- Fundamentals of Mechanical Engineering Design
- Mechanics
- Fundamentals of Materials Science
- Production Engineering

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
After passing the module, students are able to:

- explain complex working principles and functions of machine elements and of basic elements of fluidics,
- explain requirements, selection criteria, application scenarios and practical examples of complex machine elements,
- indicate the background of dimensioning calculations.

Capabilities:
After passing the module, students are able to:

- accomplish dimensioning calculations of covered machine elements,
- transfer knowledge learned in the module to new requirements and tasks (problem solving skills),
- recognize the content of technical drawings and schematic sketches,
- evaluate complex designs, technically.

Personal Competence:
Social Competence:

- Students are able to discuss technical information in the lecture supported by activating methods.

Autonomy:

- Students are able to independently deepen their acquired knowledge in exercises.
- Students are able to acquire additional knowledge and to recapitulate poorly understood content e.g. by using the video recordings of the lectures.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 68, Study Time in Lecture: 112

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Energy Systems: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Aircraft Systems Engineering: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Materials in Engineering Sciences: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Mechatronics: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Product Development and Production: Compulsory

General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Theoretical Mechanical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Energy Systems: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Aircraft Systems Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Materials in Engineering Sciences: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Mechatronics: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Product Development and Production: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Theoretical Mechanical Engineering: Compulsory
Mechanical Engineering: Kernqualifikation: Compulsory
Naval Architecture: Kernqualifikation: Compulsory

Course: Advanced Mechanical Engineering Design II (Vorlesung)

Lecturer:
Prof. Dieter Krause, Prof. Otto von Estorff

Language:
DE

Cycle:
SS

Content:
Advanced Mechanical Engineering Design I & II
Lecture

- Fundamentals of the following machine elements:
  - Linear rolling bearings
  - Axes & shafts
  - Seals
  - Clutches & brakes
  - Belt & chain drives
  - Gear drives
  - Epicyclic gears
  - Crank drives
  - Sliding bearings
- Elements of fluidics

Exercise

- Calculation methods of the following machine elements:
  - Linear rolling bearings
  - Axes & shafts
  - Clutches & brakes
  - Belt & chain drives
  - Gear drives
  - Epicyclic gears
  - Crank gears
  - Sliding bearings
- Calculations of hydrostatic systems (fluidics)

Literature:

- Dubbel, Taschenbuch für den Maschinenbau; Grote, K.-H., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.
- Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.
- Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.
- Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.
- Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.
- Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.
- Maschinenelemente – Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.
- Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.

Sowie weitere Bücher zu speziellen Themen

Course: Advanced Mechanical Engineering Design II (Übung)

Lecturer:
Prof. Dieter Krause, Prof. Otto von Estorff

Language:
DE

Cycle:
SS

Content:
Advanced Mechanical Engineering Design I & II
Lecture

- Fundamentals of the following machine elements:
  - Linear rolling bearings
  - Axes & shafts
  - Seals
  - Clutches & brakes
  - Belt & chain drives
  - Gear drives
  - Epicyclic gears
  - Crank drives
  - Sliding bearings
- Elements of fluidics

Exercise

- Calculation methods of the following machine elements:
  - Linear rolling bearings
  - Axes & shafts
  - Clutches & brakes
  - Belt & chain drives
  - Gear drives
  - Epicyclic gears
  - Crank gears
  - Sliding bearings
- Calculations of hydrostatic systems (fluidics)

Literature:

- Dubbel, Taschenbuch für den Maschinenbau; Grote, K.-H., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.
- Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.
- Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.
- Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.
- Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.
- Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.
- Maschinenelemente – Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.
- Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.

Sowie weitere Bücher zu speziellen Themen

Course: Advanced Mechanical Engineering Design I (Vorlesung)

Lecturer:
Prof. Dieter Krause, Prof. Otto von Estorff

Language:
DE

Cycle:
WS

Content:
Advanced Mechanical Engineering Design I & II
Lecture

- Fundamentals of the following machine elements:
  - Linear rolling bearings
  - Axes & shafts
  - Seals
  - Clutches & brakes
  - Belt & chain drives
  - Gear drives
  - Epicyclic gears
  - Crank drives
  - Sliding bearings
- Elements of fluidics

Exercise

- Calculation methods of the following machine elements:

  - Linear rolling bearings
  - Axes & shafts
  - Clutches & brakes
  - Belt & chain drives
  - Gear drives
  - Epicyclic gears
  - Crank gears
  - Sliding bearings
- Calculations of hydrostatic systems (fluidics)

Literature:

- Dubbel, Taschenbuch für den Maschinenbau; Grote, K.-H., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.
- Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.
- Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.
- Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.
- Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.
- Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.
- Maschinenelemente – Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.
- Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.

Sowie weitere Bücher zu speziellen Themen

Course: Advanced Mechanical Engineering Design I (Übung)

Lecturer:
Prof. Dieter Krause, Prof. Otto von Estorff

Language:
DE

Cycle:
WS

Content:
Advanced Mechanical Engineering Design I & II
Lecture

- Fundamentals of the following machine elements:
  - Linear rolling bearings
  - Axes & shafts
  - Seals
  - Clutches & brakes
  - Belt & chain drives
  - Gear drives
  - Epicyclic gears
  - Crank drives
  - Sliding bearings
- Elements of fluidics

Exercise

- Calculation methods of the following machine elements:
  - Linear rolling bearings
  - Axes & shafts
  - Clutches & brakes
  - Belt & chain drives
  - Gear drives
  - Epicyclic gears
  - Crank gears
  - Sliding bearings
- Calculations of hydrostatic systems (fluidics)

Literature:

- Dubbel, Taschenbuch für den Maschinenbau; Grote, K.-H., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.
- Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.
- Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.
- Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.
- Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.
- Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.
- Maschinenelemente – Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.
- Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.

Sowie weitere Bücher zu speziellen Themen

Module: Simulation of Dynamic Systems and Reliability

Courses:

Title	Typ	Hrs/wk
Simulation of Dynamic Systems	Vorlesung	2
Simulation of Dynamic Systems	Gruppenübung	1
Reliability of Dynamic Systems	Vorlesung	2
Reliability of Dynamic Systems	Gruppenübung	1

Module Responsibility:
Prof. Uwe Weltin

Admission Requirements:

Recommended Previous Knowledge:
Fundatmentals of mechanics, control theory and electrical engineering

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students are able to describe methods and calculations for modeling, simulation and optimization of complex mechanical systems.
Capabilities:
Students are able to apply modern algorithms for modeling of mechanical systems.

Personal Competence:
Social Competence:
Students are able to work goal-oriented in small mixed groups.
Autonomy:
Students are able to recognize and improve knowledge deficits independently.
With instructor assistance, students are able to evaluate their own knowledge level and define a further course of study.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 96, Study Time in Lecture: 84

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Aircraft Systems Engineering: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Mechatronics: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Theoretical Mechanical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Aircraft Systems Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Mechatronics: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Theoretical Mechanical Engineering: Compulsory
Mechanical Engineering: Vertiefung Aircraft Systems Engineering: Compulsory
Mechanical Engineering: Vertiefung Theoretical Mechanical Engineering: Compulsory
Mechanical Engineering: Vertiefung Mechatronics: Compulsory
Mechatronics: Kernqualifikation: Compulsory

Course: Simulation of Dynamic Systems (Vorlesung)

Lecturer:
Prof. Uwe Weltin

Language:
DE

Cycle:
WS

Content:
Modeling
Model Identifikation
Numerical Methods in simulation
Applications and examples in Matlab® and Simulink®

Literature:
Skript zur Veranstaltung
Weitere Literatur in der Veranstaltung

Course: Simulation of Dynamic Systems (Übung)

Lecturer:
Prof. Uwe Weltin

Language:
DE

Cycle:
WS

Content:
Modeling
Model Identifikation
Numerical Methods in simulation
Applications and examples in Matlab® and Simulink®

Literature:
Skript zur Veranstaltung
Weitere Literatur in der Veranstaltung

Course: Reliability of Dynamic Systems (Vorlesung)

Lecturer:
Prof. Uwe Weltin

Language:
DE

Cycle:
WS

Content:
Methods for prediction and validation of life cycle of components and systems
Modeling, simulation, parameter identificaiton
Load data analysis and damage accumulation
Fatigue testing

Literature:
Bertsche, B.: Reliability in Automotive and Mechanical Engineering. Springer, 2008. ISBN: 978-3-540-33969-4
Inman, Daniel J.: Engineering Vibration. Prentice Hall, 3rd Ed., 2007. ISBN-13: 978-0132281737
Dresig, H., Holzweißig, F.: Maschinendynamik, Springer Verlag, 9. Auflage, 2009. ISBN 3540876936.
VDA (Hg.): Zuverlässigkeitssicherung bei Automobilherstellern und Lieferanten. Band 3 Teil 2, 3. überarbeitete Auflage, 2004. ISSN 0943-9412

Course: Reliability of Dynamic Systems (Übung)

Lecturer:
Prof. Uwe Weltin

Language:
DE

Cycle:
WS

Content:
Methods for prediction and validation of life cycle of components and systems
Modeling, simulation, parameter identificaiton
Load data analysis and damage accumulation
Fatigue testing

Literature:
Bertsche, B.: Reliability in Automotive and Mechanical Engineering. Springer, 2008. ISBN: 978-3-540-33969-4
Inman, Daniel J.: Engineering Vibration. Prentice Hall, 3rd Ed., 2007. ISBN-13: 978-0132281737
Dresig, H., Holzweißig, F.: Maschinendynamik, Springer Verlag, 9. Auflage, 2009. ISBN 3540876936.
VDA (Hg.): Zuverlässigkeitssicherung bei Automobilherstellern und Lieferanten. Band 3 Teil 2, 3. überarbeitete Auflage, 2004. ISSN 0943-9412

Module: Electrical Engineering III: Circuit Theory and Transients

Courses:

Title	Typ	Hrs/wk
Circuit Theory	Vorlesung	3
Circuit Theory	Gruppenübung	2

Module Responsibility:
Prof. Arne Jacob

Admission Requirements:

Recommended Previous Knowledge:
Electrical Engineering I and II, Mathematics I and II

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students are able to explain the basic methods for calculating electrical circuits. They know the Fourier series analysis of linear networks driven by periodic signals. They know the methods for transient analysis of linear networks in time and in frequency domain, and they are able to explain the frequency behaviour and the synthesis of passive two-terminal-circuits.

Capabilities:
The students are able to calculate currents and voltages in linear networks by means of basic methods, also when driven by periodic signals. They are able to calculate transients in electrical circuits in time and frequency domain and are able to explain the respective transient behaviour. They are able to analyse and to synthesize the frequency behaviour of passive two-terminal-circuits.

Personal Competence:
Social Competence:
Students work on exercise tasks in small guided groups. They are encouraged to present and discuss their results within the group.

Autonomy:
The students are able to find out the required methods for solving the given practice problems. Possibilities are given to test their knowledge during the lectures continuously by means of short-time tests. This allows them to control independently their educational objectives. They can link their gained knowledge to other courses like Electrical Engineering I and Mathematics I.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 110, Study Time in Lecture: 70

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Electrical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Mechatronics: Compulsory
Electrical Engineering: Kernqualifikation: Compulsory
Electrical Engineering myTrack: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Electrical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Mechatronics: Compulsory
Mechatronics: Kernqualifikation: Compulsory
Technomathematics: Vertiefung Engineering Science: Compulsory suffrage

Course: Circuit Theory (Vorlesung)

Lecturer:
Prof. Arne Jacob

Language:
DE

Cycle:
WS

Content:
- Circuit theorems
- N-port circuits
- Periodic excitation of linear circuits

- Transient analysis in time domain
- Transient analysis in frequency domain; Laplace Transform
- Frequency behaviour of passive one-ports

Literature:

- M. Albach, "Grundlagen der Elektrotechnik 1", Pearson Studium (2011)
- M. Albach, "Grundlagen der Elektrotechnik 2", Pearson Studium (2011)
- L. P. Schmidt, G. Schaller, S. Martius, "Grundlagen der Elektrotechnik 3", Pearson Studium (2011)
- T. Harriehausen, D. Schwarzenau, "Moeller Grundlagen der Elektrotechnik", Springer (2013)
- A. Hambley, "Electrical Engineering: Principles and Applications", Pearson (2008)
- R. C. Dorf, J. A. Svoboda, "Introduction to electrical circuits", Wiley (2006)
- L. Moura, I. Darwazeh, "Introduction to Linear Circuit Analysis and Modeling", Amsterdam Newnes (2005)

Course: Circuit Theory (Übung)

Lecturer:
Prof. Arne Jacob

Language:
DE

Cycle:
WS

Content:

Literature:

Module: Semiconductor Circuit Design

Courses:

Title	Typ	Hrs/wk
Semiconductor Circuit Design	Vorlesung	3
Semiconductor Circuit Design	Gruppenübung	1

Module Responsibility:
Prof. Wolfgang Krautschneider

Admission Requirements:
none

Recommended Previous Knowledge:
Fundamentals of electrical engineering
Basics of physics

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:

- Students are able to explain the functionality of different MOS devices in electronic circuits.
- Students know the fundamental digital logic circuits and can discuss their advantages and disadvantages.
- Students have solid knowledge about memory circuits and can explain their functionality and specifications.
- Students are able to explain how analog circuits functions and where they are applied.
- Students know the appropriate fields for the use of bipolar transistors.

Capabilities:

- Students can calculate the specifications of different MOS devices and can define the parameters of electronic circuits.
- Students are able to develop different logic circuits and can design different types of logic circuits.
- Students can use MOS devices, operational amplifiers and bipolar transistors for specific applications.

Personal Competence:
Social Competence:

- Students are able work efficiently in heterogeneous teams.
- Students working together in small groups can solve problems and answer professional questions.

Autonomy:

- Students are able to assess their level of knowledge.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Electrical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Mechatronics: Compulsory
Computer Science: Vertiefung Computer Engineering: Compulsory suffrage
Electrical Engineering: Kernqualifikation: Compulsory
Electrical Engineering myTrack: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Electrical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Mechatronics: Compulsory
Computational Science and Engineering: Vertiefung Computer Science: Compulsory suffrage
Mechanical Engineering: Vertiefung Mechatronics: Compulsory
Mechatronics: Kernqualifikation: Compulsory
Technomathematics: Kernqualifikation: Compulsory suffrage

Course: Semiconductor Circuit Design (Vorlesung)

Lecturer:

Prof. Wolfgang Krautschneider

Language:
DE

Cycle:
SS

Content:

- Basic circuits with MOS transistors for logic gates and amplifiers
- Typical applications for analog and digital circuits
- Realization of logical functions
- Memory circuits
- Scaling-down of CMOS circuits and further perfomance improvements
- Operational amplifiers and their applications
- Basic circuits with bipolar transistors
- Design of exemplary circuits
- Electrical behavoir of BiCMOS circuits

Literature:
R. J. Baker, CMOS - Circuit Design, Layout and Simulation, J. Wiley & Sons Inc., 3. Auflage, 2011, ISBN: 047170055S
H.-G. Wagemann und T. Schönauer, Silizium-Planartechnologie, Grundprozesse, Physik und Bauelemente, Teubner-Verlag, 2003, ISBN 3519004674
K. Hoffmann, Systemintegration, Oldenbourg-Verlag, 2. Aufl. 2006, ISBN: 3486578944
U. Tietze und Ch. Schenk, E. Gamm, Halbleiterschaltungstechnik, Springer Verlag, 14. Auflage, 2012, ISBN 3540428496
H. Göbel, Einführung in die Halbleiter-Schaltungstechnik, Berlin, Heidelberg Springer-Verlag Berlin Heidelberg, 2011, ISBN: 9783642208874 ISBN: 9783642208867
URL: http://site.ebrary.com/lib/alltitles/docDetail.action?docID=10499499
URL: http://dx.doi.org/10.1007/978-3-642-20887-4
URL: http://ebooks.ciando.com/book/index.cfm/bok_id/319955
URL: http://www.ciando.com/img/bo

Course: Semiconductor Circuit Design (Übung)

Lecturer:
Prof. Wolfgang Krautschneider

Language:
DE

Cycle:
SS

Content:

- Basic circuits with MOS transistors for logic gates and amplifiers
- Typical applications for analog and digital circuits
- Realization of logical functions
- Memory circuits
- Scaling-down of CMOS circuits and further perfomance improvements
- Operational amplifiers and their applications
- Basic circuits with bipolar transistors
- Design of exemplary circuits
- Electrical behavoir of BiCMOS circuits

Literature:
R. J. Baker, CMOS - Circuit Design, Layout and Simulation, J. Wiley & Sons Inc., 3. Auflage, 2011, ISBN: 047170055S
H.-G. Wagemann und T. Schönauer, Silizium-Planartechnologie, Grundprozesse, Physik und Bauelemente, Teubner-Verlag, 2003, ISBN 3519004674
K. Hoffmann, Systemintegration, Oldenbourg-Verlag, 2. Aufl. 2006, ISBN: 3486578944
U. Tietze und Ch. Schenk, E. Gamm, Halbleiterschaltungstechnik, Springer Verlag, 14. Auflage, 2012, ISBN 3540428496
H. Göbel, Einführung in die Halbleiter-Schaltungstechnik, Berlin, Heidelberg Springer-Verlag Berlin Heidelberg, 2011, ISBN: 9783642208874 ISBN: 9783642208867
URL: http://site.ebrary.com/lib/alltitles/docDetail.action?docID=10499499
URL: http://dx.doi.org/10.1007/978-3-642-20887-4
URL: http://ebooks.ciando.com/book/index.cfm/bok_id/319955
URL: http://www.ciando.com/img/bo

Courses:

Title	Typ	Hrs/wk
Differential Equations 2 (Partial Differential Equations)	Vorlesung	2
Differential Equations 2 (Partial Differential Equations)	Gruppenübung	1
Differential Equations 2 (Partial Differential Equations)	Hörsaalübung	1
Complex Functions	Vorlesung	2
Complex Functions	Gruppenübung	1
Complex Functions	Hörsaalübung	1

Module Responsibility:
Prof. Anusch Taraz

Admission Requirements:
none

Recommended Previous Knowledge:
Mathematics 1 - III

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:

- Students can name the basic concepts in Mathematics IV. They are able to explain them using appropriate examples.
- Students can discuss logical connections between these concepts. They are capable of illustrating these connections with the help of examples.
- They know proof strategies and can reproduce them.

Capabilities:

- Students can model problems in Mathematics IV with the help of the concepts studied in this course. Moreover, they are capable of solving them by applying established methods.
- Students are able to discover and verify further logical connections between the concepts studied in the course.
- For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results.

Personal Competence:
Social Competence:

- Students are able to work together in teams. They are capable to use mathematics as a common language.
- In doing so, they can communicate new concepts according to the needs of their cooperating partners. Moreover, they can design examples to check and deepen the understanding of their peers.

Autonomy:

- Students are capable of checking their understanding of complex concepts on their own. They can specify open questions precisely and know where to get help in solving them.
- Students have developed sufficient persistence to be able to work for longer periods in a goal-oriented manner on hard problems.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 68, Study Time in Lecture: 112

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Electrical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Mechatronics: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Theoretical Mechanical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Naval Architecture: Compulsory
Computer Science: Vertiefung Computational Mathematics: Compulsory suffrage
Electrical Engineering: Kernqualifikation: Compulsory

Electrical Engineering myTrack: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Electrical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Naval Architecture: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Mechatronics: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Theoretical Mechanical Engineering: Compulsory
Computational Science and Engineering: Vertiefung Engineering Sciences: Compulsory suffrage
Mechanical Engineering: Vertiefung Theoretical Mechanical Engineering: Compulsory
Mechanical Engineering: Vertiefung Mechatronics: Compulsory
Mechatronics: Kernqualifikation: Compulsory
Naval Architecture: Kernqualifikation: Compulsory

Course: Differential Equations 2 (Partial Differential Equations) (Vorlesung)

Lecturer:
Dozenten des Fachbereiches Mathematik der UHH

Language:
DE

Cycle:
SS

Content:
Main features of the theory and numerical treatment of partial differential equations

- Examples of partial differential equations
- First order quasilinear differential equations
- Normal forms of second order differential equations
- Harmonic functions and maximum principle
- Maximum principle for the heat equation
- Wave equation
- Liouville's formula
- Special functions
- Difference methods
- Finite elements

Literature:

- R. Ansorge, H. J. Oberle: Mathematik für Ingenieure, Band 2; Verlag Wiley-VCH, Berlin, Weinheim, New York, 2000
- P. Henrici, R. Jelsch: Komplexe Analysis für Ingenieure, Birkhäuser Verlag, Basel, 1998
- A. Tveito, R. Winther: Einführung in partielle Differentialgleichungen, Springer Verlag, Berlin, Heidelberg, New York, 2002

Course: Differential Equations 2 (Partial Differential Equations) (Übung)

Lecturer:
Dozenten des Fachbereiches Mathematik der UHH

Language:
DE

Cycle:
SS

Content:
Main features of the theory and numerical treatment of partial differential equations

- Examples of partial differential equations
- First order quasilinear differential equations
- Normal forms of second order differential equations
- Harmonic functions and maximum principle
- Maximum principle for the heat equation
- Wave equation
- Liouville's formula
- Special functions
- Difference methods
- Finite elements

Literature:

- R. Ansorge, H. J. Oberle: Mathematik für Ingenieure, Band 2; Verlag Wiley-VCH, Berlin, Weinheim, New York, 2000
- P. Henrici, R. Jelsch: Komplexe Analysis für Ingenieure, Birkhäuser Verlag, Basel, 1998
- A. Tveito, R. Winther: Einführung in partielle Differentialgleichungen, Springer Verlag, Berlin, Heidelberg, New York, 2002

Course: Differential Equations 2 (Partial Differential Equations) (Ubung)

Lecturer:
Dozenten des Fachbereiches Mathematik der UHH

Language:
DE

Cycle:
SS

Content:
Main features of the theory and numerical treatment of partial differential equations

- Examples of partial differential equations
- First order quasilinear differential equations
- Normal forms of second order differential equations
- Harmonic functions and maximum principle
- Maximum principle for the heat equation
- Wave equation
- Liouville's formula
- Special functions
- Difference methods
- Finite elements

Literature:

- R. Ansorge, H. J. Oberle: Mathematik für Ingenieure, Band 2; Verlag Wiley-VCH, Berlin, Weinheim, New York, 2000
- P. Henrici, R. Jelsch: Komplexe Analysis für Ingenieure, Birkhäuser Verlag, Basel, 1998
- A. Tveito, R. Winther: Einführung in partielle Differentialgleichungen, Springer Verlag, Berlin, Heidelberg, New York, 2002

Course: Complex Functions (Vorlesung)

Lecturer:
Dozenten des Fachbereiches Mathematik der UHH

Language:
DE

Cycle:
SS

Content:
Main features of complex analysis

- Functions of one complex variable
- Complex differentiation
- Conformal mappings
- Complex integration
- Cauchy's integral theorem
- Cauchy's integral formula
- Taylor and Laurent series expansion
- Singularities and residuals
- Integral transformations: Fourier and Laplace transformation

Literature:

- R. Ansorge, H. J. Oberle: Mathematik für Ingenieure, Band 2; Verlag Wiley-VCH, Berlin, Weinheim, New York, 2000
- P. Henrici, R. Jelsch: Komplexe Analysis für Ingenieure, Birkhäuser Verlag, Basel, 1998

Course: Complex Functions (Übung)

Lecturer:
Dozenten des Fachbereiches Mathematik der UHH

Language:
DE

Cycle:
SS

Content:
Main features of complex analysis

- Functions of one complex variable
- Complex differentiation
- Conformal mappings

- Complex integration
- Cauchy's integral theorem
- Cauchy's integral formula
- Taylor and Laurent series expansion
- Singularities and residuals
- Integral transformations: Fourier and Laplace transformation

Literature:

- R. Ansorge, H. J. Oberle: Mathematik für Ingenieure, Band 2; Verlag Wiley-VCH, Berlin, Weinheim, New York, 2000
- P. Henrici, R. Jelsch: Komplexe Analysis für Ingenieure, Birkhäuser Verlag, Basel, 1998

Course: Complex Functions (Übung)

Lecturer:
Dozenten des Fachbereiches Mathematik der UHH

Language:
DE

Cycle:
SS

Content:
Main features of complex analysis

- Functions of one complex variable
- Complex differentiation
- Conformal mappings
- Complex integration
- Cauchy's integral theorem
- Cauchy's integral formula
- Taylor and Laurent series expansion
- Singularities and residuals
- Integral transformations: Fourier and Laplace transformation

Literature:

- R. Ansorge, H. J. Oberle: Mathematik für Ingenieure, Band 2; Verlag Wiley-VCH, Berlin, Weinheim, New York, 2000
- P. Henrici, R. Jelsch: Komplexe Analysis für Ingenieure, Birkhäuser Verlag, Basel, 1998

Focus Product Development and Production

Module: Advanced Mechanical Engineering Design

Courses:

Title	Typ	Hrs/wk
Advanced Mechanical Engineering Design II	Vorlesung	2
Advanced Mechanical Engineering Design II	Hörsaalübung	2
Advanced Mechanical Engineering Design I	Vorlesung	2
Advanced Mechanical Engineering Design I	Hörsaalübung	2

Module Responsibility:
Prof. Dieter Krause

Admission Requirements:
None

Recommended Previous Knowledge:

- Fundamentals of Mechanical Engineering Design
- Mechanics
- Fundamentals of Materials Science
- Production Engineering

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
After passing the module, students are able to:

- explain complex working principles and functions of machine elements and of basic elements of fluidics,
- explain requirements, selection criteria, application scenarios and practical examples of complex machine elements,
- indicate the background of dimensioning calculations.

Capabilities:
After passing the module, students are able to:

- accomplish dimensioning calculations of covered machine elements,
- transfer knowledge learned in the module to new requirements and tasks (problem solving skills),
- recognize the content of technical drawings and schematic sketches,
- evaluate complex designs, technically.

Personal Competence:
Social Competence:

- Students are able to discuss technical information in the lecture supported by activating methods.

Autonomy:

- Students are able to independently deepen their acquired knowledge in exercises.
- Students are able to acquire additional knowledge and to recapitulate poorly understood content e.g. by using the video recordings of the lectures.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 68, Study Time in Lecture: 112

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Energy Systems: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Aircraft Systems Engineering: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Materials in Engineering Sciences: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Mechatronics: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Product Development and Production: Compulsory

General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Theoretical Mechanical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Energy Systems: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Aircraft Systems Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Materials in Engineering Sciences: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Mechatronics: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Product Development and Production: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Theoretical Mechanical Engineering: Compulsory
Mechanical Engineering: Kernqualifikation: Compulsory
Naval Architecture: Kernqualifikation: Compulsory

Course: Advanced Mechanical Engineering Design II (Vorlesung)

Lecturer:
Prof. Dieter Krause, Prof. Otto von Estorff

Language:
DE

Cycle:
SS

Content:
Advanced Mechanical Engineering Design I & II
Lecture

- Fundamentals of the following machine elements:
  - Linear rolling bearings
  - Axes & shafts
  - Seals
  - Clutches & brakes
  - Belt & chain drives
  - Gear drives
  - Epicyclic gears
  - Crank drives
  - Sliding bearings
- Elements of fluidics

Exercise

- Calculation methods of the following machine elements:
  - Linear rolling bearings
  - Axes & shafts
  - Clutches & brakes
  - Belt & chain drives
  - Gear drives
  - Epicyclic gears
  - Crank gears
  - Sliding bearings
- Calculations of hydrostatic systems (fluidics)

Literature:

- Dubbel, Taschenbuch für den Maschinenbau; Grote, K.-H., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.
- Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.
- Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.
- Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.
- Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.
- Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.
- Maschinenelemente – Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.
- Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.

Sowie weitere Bücher zu speziellen Themen

Course: Advanced Mechanical Engineering Design II (Übung)

Lecturer:
Prof. Dieter Krause, Prof. Otto von Estorff

Language:
DE

Cycle:
SS

Content:
Advanced Mechanical Engineering Design I & II
Lecture

- Fundamentals of the following machine elements:
  - Linear rolling bearings
  - Axes & shafts
  - Seals
  - Clutches & brakes
  - Belt & chain drives
  - Gear drives
  - Epicyclic gears
  - Crank drives
  - Sliding bearings
- Elements of fluidics

Exercise

- Calculation methods of the following machine elements:
  - Linear rolling bearings
  - Axes & shafts
  - Clutches & brakes
  - Belt & chain drives
  - Gear drives
  - Epicyclic gears
  - Crank gears
  - Sliding bearings
- Calculations of hydrostatic systems (fluidics)

Literature:

- Dubbel, Taschenbuch für den Maschinenbau; Grote, K.-H., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.
- Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.
- Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.
- Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.
- Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.
- Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.
- Maschinenelemente – Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.
- Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.

Sowie weitere Bücher zu speziellen Themen

Course: Advanced Mechanical Engineering Design I (Vorlesung)

Lecturer:
Prof. Dieter Krause, Prof. Otto von Estorff

Language:
DE

Cycle:
WS

Content:
Advanced Mechanical Engineering Design I & II
Lecture

- Fundamentals of the following machine elements:
  - Linear rolling bearings
  - Axes & shafts
  - Seals
  - Clutches & brakes
  - Belt & chain drives
  - Gear drives
  - Epicyclic gears
  - Crank drives
  - Sliding bearings
- Elements of fluidics

Exercise

- Calculation methods of the following machine elements:

  - Linear rolling bearings
  - Axes & shafts
  - Clutches & brakes
  - Belt & chain drives
  - Gear drives
  - Epicyclic gears
  - Crank gears
  - Sliding bearings
- Calculations of hydrostatic systems (fluidics)

Literature:

- Dubbel, Taschenbuch für den Maschinenbau; Grote, K.-H., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.
- Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.
- Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.
- Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.
- Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.
- Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.
- Maschinenelemente – Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.
- Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.

Sowie weitere Bücher zu speziellen Themen

Course: Advanced Mechanical Engineering Design I (Übung)

Lecturer:
Prof. Dieter Krause, Prof. Otto von Estorff

Language:
DE

Cycle:
WS

Content:
Advanced Mechanical Engineering Design I & II
Lecture

- Fundamentals of the following machine elements:
  - Linear rolling bearings
  - Axes & shafts
  - Seals
  - Clutches & brakes
  - Belt & chain drives
  - Gear drives
  - Epicyclic gears
  - Crank drives
  - Sliding bearings
- Elements of fluidics

Exercise

- Calculation methods of the following machine elements:
  - Linear rolling bearings
  - Axes & shafts
  - Clutches & brakes
  - Belt & chain drives
  - Gear drives
  - Epicyclic gears
  - Crank gears
  - Sliding bearings
- Calculations of hydrostatic systems (fluidics)

Literature:

- Dubbel, Taschenbuch für den Maschinenbau; Grote, K.-H., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.
- Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.
- Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.
- Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.
- Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.
- Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.
- Maschinenelemente – Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.
- Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.

Sowie weitere Bücher zu speziellen Themen

Courses:

Title	Typ	Hrs/wk
Advanced Mechanical Design Project	Testat	4

Module Responsibility:
Prof. Dieter Krause

Admission Requirements:
None

Recommended Previous Knowledge:

- Mechanical Engineering: Design
- Advanced Mechanical Engineering Design

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
After passing the module, students are able to:

- express the procedure for systematically handling of
- complex design tasks ,
- describe working principles, their use and combination possibilities,
- explain guidelines for designing for function and manufacturing,
- explain advanced use-oriented knowledge of machine elements.

Capabilities:
After passing the module, students are able to:

- analyze complex tasks and develop principle solutions using sketches,
- convert principle solutions into a detailed design,
- use methods to design and solve engineering design tasks systematically and solution-oriented,
- create a technical documentation including all necessary technical drawings to understand the functions of the system,
- document calculations of selected machine elements clearly and in detail.

Personal Competence:
Social Competence:
After passing the module, students are able to:

- present and discuss solutions and technical drawings within groups,
- reflect the own results in the work groups of the course

Autonomy:
After passing the module, students are able to:

- independently solve complex design projects, while motivating themselves, acquiring necessary knowledge and selecting appropriate methods,
- to independently solve problems.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Aircraft Systems Engineering: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Product Development and Production: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Theoretical Mechanical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Aircraft Systems Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Product Development and Production: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Theoretical Mechanical Engineering: Compulsory

Course: Advanced Mechanical Design Project (Testat)

Lecturer:
Prof. Dieter Krause, Prof. Otto von Estorff, Dr. Jens Schmidt, Dr. Volkert Wollesen

Language:
DE

Cycle:
WS

Content:
Das Konstruktionsprojekt gliedert sich in den Entwurf eines Getriebes sowie die Lösungsfindung.

- Getriebekonstruktion in Einzelarbeit
  - Erarbeitung von Lösungsprinzipien
  - Berechnung von Maschinenelementen
  - Entwurf eines Getriebes im Hauptschnitt plus allen Außenansichten
  - Erstellung einer ausführlichen Dokumentation
- Lösungsfindung
  - Methodische Erarbeitung von prinzipiellen Lösungskonzepten
  - Erstellen einer Dokumentation

Literature:

- Dubbel, Taschenbuch für den Maschinenbau; Grote, K.-H., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.
- Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.
- Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.
- Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.
- Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.
- Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.
- Maschinenelemente – Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.
- Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.
- Sowie weitere Bücher zu speziellen Themen

Courses:

Title	Typ	Hrs/wk
Fundamentals of Machine Tools	Vorlesung	3
Forming and Cutting Technology	Vorlesung	2
Forming and Cutting Technology	Hörsaalübung	1

Module Responsibility:
Prof. Wolfgang Hintze

Admission Requirements:
None

Recommended Previous Knowledge:
without major course assessment
internship recommended
Previous knowledge in mathematics, mechanics and electrical engineering

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students are able to ...

- explain the basics of chip formation and mechanisms and models of machining.
- explain methods and parameters for design and analysis of metal forming, machining processes and tools.
- explain technical concepts of machine tool building and give an overview on trends in the machine tool industry.
- explain types, constructions and functions of CNC-machines and give an overview on multi-machine systems.
- explain equipment components.

Capabilities:
Students are able to...

- select tool geometry, cutting materials, process parameters and appropriate measuring technique in accordance with the requirements.
- estimate occurring forces and temperatures during chip formation.
- select appropriate machine tools for machining and create NC programs for turning and milling.
- assess the quality of a machine tools and to detect weak points.

Personal Competence:
Social Competence:
Students are able to ...

- develop solutions in a production environment with qualified personnel at technical level and represent decisions.

Autonomy:
Students are able to ...

- interpret independently cutting processes.
- create independently NC programs.
- select independently machine tools by reference to appropriate requirements.
- assess own strengths and weaknesses in general.
- assess their learning progress and define gaps to be improved.
- assess possible consequences of their actions.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 96, Study Time in Lecture: 84

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Product Development and Production: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Product Development and Production: Compulsory
Mechanical Engineering: Vertiefung Product Development and Production: Compulsory

Course: Fundamentals of Machine Tools (Vorlesung)

Lecturer:
Prof. Thorsten Schüppstuhl

Language:
DE

Cycle:
WS

Content:
Terminology and trends in machine tool building
CNC controls
NC programming and NC programming systems
Types, construction and function of CNC machines
Multi-machine systems
Equipment components for machine tools
Assessment of machine tools

Literature:
Conrad, K.J
Taschenbuch der Werkzeugmaschinen
9783446406414
Fachbuchverlag 2006

Perović, Božina
Spanende Werkzeugmaschinen - Ausführungsformen und Vergleichstabellen
ISBN: 3540899529
Berlin [u.a.]: Springer, 2009

Weck, Manfred
Werkzeugmaschinen 1 - Maschinenarten und Anwendungsbereiche
ISBN: 9783540225041
Berlin [u.a.]: Springer, 2005

Weck, Manfred; Brecher, Christian
Werkzeugmaschinen 4 - Automatisierung von Maschinen und Anlagen
ISBN: 3540225072
Berlin [u.a.]: Springer, 2006

Weck, Manfred; Brecher, Christian
Werkzeugmaschinen 5 - Messtechnische Untersuchung und Beurteilung, dynamische Stabilität
ISBN: 3540225056
Berlin [u.a.]: Springer, 2006

Course: Forming and Cutting Technology (Vorlesung)

Lecturer:
Prof. Wolfgang Hintze

Language:
DE

Cycle:
WS

Content:

- Thermomechanical Principles and Models of Machining
- Chip Formation, Forces, Temperature and Tribology process
- Wear mechanisms and wear patterns
- Machinability by Cutting and Forming, Specific Problems of Light Weight Structures
- Cutting Material and Coatings
- Methods and Parameters for Analysis and Configuration of Forming and Cutting Processes and Tools

Literature:
Lange, K.; Umformtechnik Grundlagen, 2. Auflage, Springer (2002)
Tönshoff, H.; Spanen Grundlagen, 2. Auflage, Springer Verlag (2004)
König, W., Klocke, F.; Fertigungsverfahren Bd. 4 *Massivumformung*, 4. Auflage, VDI-Verlag (1996)
König, W., Klocke, F.; Fertigungsverfahren Bd. 5 *Blechbearbeitung*, 3. Auflage, VDI-Verlag (1995)
Klocke, F., König, W.; Fertigungsverfahren *Schleifen, Honen, Läppen*, 4. Auflage, Springer Verlag (2005)
König, W., Klocke, F.: Fertigungsverfahren *Drehen, Fräsen, Bohren,* 7. Auflage, Springer Verlag (2002)

Course: Forming and Cutting Technology (Übung)

Lecturer:
Prof. Wolfgang Hintze

Language:
DE

Cycle:
WS

Content:

- Thermomechanical Principles and Models of Machining
- Chip Formation, Forces, Temperature and Tribology process
- Wear mechanisms and wear patterns
- Machinability by Cutting and Forming, Specific Problems of Light Weight Structures
- Cutting Material and Coatings
- Methods and Parameters for Analysis and Configuration of Forming and Cutting Processes and Tools

Literature:

Lange, K.; Umformtechnik Grundlagen, 2. Auflage, Springer (2002)
Tönshoff, H.; Spanen Grundlagen, 2. Auflage, Springer Verlag (2004)
König, W., Klocke, F.; Fertigungsverfahren Bd. 4 *Massivumformung*, 4. Auflage, VDI-Verlag (1996)
König, W., Klocke, F.; Fertigungsverfahren Bd. 5 *Blechbearbeitung*, 3. Auflage, VDI-Verlag (1995)
Klocke, F., König, W.; Fertigungsverfahren *Schleifen, Honen, Läppen*, 4. Auflage, Springer Verlag (2005)
König, W., Klocke, F.: Fertigungsverfahren *Drehen, Fräsen, Bohren,* 7. Auflage, Springer Verlag (2002)

Module: Material Science Laboratory

Courses:

Title	Typ	Hrs/wk
Companion Lecture for Materials Science Laboratory	Vorlesung	2
Material Science Laboratory	Laborpraktikum	4

Module Responsibility:
Prof. Bodo Fiedler

Admission Requirements:
none

Recommended Previous Knowledge:
none

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students are able to give a summary of the technical details of experiments in the area of materials sciences and illustrate respective relationships. They are capable of describing and communicating relevant problems and questions using appropriate technical language. They can explain the typical process of solving practical problems and present related results.
Capabilities:
The students can transfer their fundamental knowledge on material sciences to the process of solving practical problems. They identify and overcome typical problems during the realization of experiments in the context of material sciences.

Personal Competence:
Social Competence:
Students are able to cooperate in small groups in order to conduct experiments in the context of materials sciences. They are able to effectively present and explain their results alone or in groups in front of a qualified audience.
Autonomy:
Students are capable of solving problems in the context of materials sciences using provided literature. They are able to fill gaps in as well as extent their knowledge using the literature and other sources provided by the supervisor.

ECTS-Credit points:
6 LP

Examination:
Kolloquium

Workload in Hours:
Indipendent Study Time: 96, Study Time in Lecture: 84

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Materials in Engineering Sciences: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Product Development and Production: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Materials in Engineering Sciences: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Product Development and Production: Compulsory
Mechanical Engineering: Vertiefung Product Development and Production: Compulsory
Mechanical Engineering: Vertiefung Materials in Engineering Sciences: Compulsory

Course: Companion Lecture for Materials Science Laboratory (Vorlesung)

Lecturer:
Prof. Patrick Huber

Language:
DE

Cycle:
WS

Content:
Physico-chemical backgrounds and fundamental experimental principles with regard to the following experiments, the topics to be addressed are indicated in brackets for each experiment:
1. Phase diagrams, heat treatment, hardness measurements (thermodynamics, elastic properties of solids)
2. notch impact test (elastic properties of solids)
3. Processes during the solidifaction of metals (thermodynamics and kinetics of solid-liquid phase transitions)
4. tensile test (elastic properties of solids)

5. Identificiation of polymers (polymer physics)
6. fiber-reinforced polymers (physical principles of composite materials)
7. Production and microstructure of ceramic materials (physico-chemical principles of ceramics)
8. Mechanical properties of ceramic materials (elastic properties of solids and composite materials)

Literature:

William D. Callister und David G. Rethwisch, Materialwissenschaften und Werkstofftechnik, Wiley&Sons, Asia (2011)
William D. Callister, Materials Science and Technology, Wiley& Sons, Inc. (2007)

Course: Material Science Laboratory (Laborpraktikum)

Lecturer:

Prof. Bodo Fiedler, Prof. Stefan Müller, Prof. Patrick Huber, Prof. Gerold Schneider, Prof. Jörg Weißmüller

Language:

DE

Cycle:

WS

Content:

8 Versuche:
Zustandsdiagramm, Wärmebehandlung, Härtemessung
Kerbschlagbiegeversuch
Vorgänge bei der Erstarrung von Metallen
Zugversuch
Identifizierung von Kunststoffen
Faserverstärkte Kunststoffe
Herstellung und Gefüge keramischer Werkstoffe
Mechanisches Verhalten keramischer Werkstoffe

Literature:

Vorlesungsunterlagen Grundlagen der Werkstoffwissenschaft I & II

Courses:

Title	Typ	Hrs/wk
CAE-Team Project	Problemorientierte Lehrveranstaltung	2
Development of Lightweight Design Products	Vorlesung	2
Integrated Product Development I	Vorlesung	2

Module Responsibility:
Prof. Dieter Krause

Admission Requirements:

Recommended Previous Knowledge:
Advanced Knowledge about engineering design:
Fundamentals of Mechanical Engineering Design
Mechanical Engineering: Design
Advanced Mechanical Engineering Design

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
After completing the module, students are capable of:

- explaining the functional principle of 3D-CAD-Systems, PDM- and FEM-Systems
- describing the interaction of the different CAE-Systems in the product development process

Capabilities:

After completing the module, students are able to:

- evaluate different CAD- and PDM-Systems with regards to the desired requirements such as classification schemes and product structuring
- design an exemplary product using CAD-,PDM- and/or FEM-Systems with shared workload

Personal Competence:
Social Competence:
After completing the module, students are able to:

- To develop a project plan and allocate work appropriate work packages in the framework of group discussions
- Present project results as a team for instance in a presentation

Autonomy:
Students are capable of:

- independently adapt to a CAE-Tool and complete a given practical task with it

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 96, Study Time in Lecture: 84

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Aircraft Systems Engineering: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Product Development and Production: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Aircraft Systems Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Product Development and Production: Compulsory
Mechanical Engineering: Vertiefung Product Development and Production: Compulsory
Mechanical Engineering: Vertiefung Aircraft Systems Engineering: Compulsory

Course: CAE-Team Project (Problemorientierte Lehrveranstaltung)

Lecturer:
Prof. Dieter Krause

Language:
DE

Cycle:
SS

Content:

- Practical Introduction in the used software systems (Creo, Windchill, Hyperworks)
- Team formation, allocation of tasks and generation of a project plan
- Collective creation of one product out of CAD models supported by FEM calculations and PDM system
- Manufacturing of selected parts using 3D printer
- Presentation of results

Description
Part of the module is a project based team orientated practical course using the PBL method. In this course, students learn the handling of modern CAD, PDM and FEM systems (Creo, Windchill and Hyperworks). After a short introduction in the applied software systems, students work in teams on a task during the semester. The aim is the development of one product out of several CAD parts models using a PDM system including FEM calculations of selected parts and 3D printing of parts. The developed product must be presented in a joint presentation.

Literature:
-

Course: Development of Lightweight Design Products (Vorlesung)

Lecturer:
Prof. Dieter Krause

Language:
DE

Cycle:
SS

Content:

- Lightweight design materials
- Product development process for lightweight structures
- Dimensioning of lightweight structures

Literature:

- Schürmann, H., „Konstruieren mit Faser-Kunststoff-Verbunden“, Springer, Berlin, 2005.
- Klein, B., „Leichtbau-Konstruktion", Vieweg & Sohn, Braunschweig, 1989.
- Krause, D., „Leichtbau”, In: Handbuch Konstruktion, Hrsg.: Rieg, F., Steinhilper, R., München, Carl Hanser Verlag, 2012.
- Schulte, K., Fiedler, B., „Structure and Properties of Composite Materials”, Hamburg, TUHH - TuTech Innovation GmbH, 2005.
- Wiedemann, J., „Leichtbau Band 1: Elemente“, Springer, Berlin, Heidelberg, 1986.

Course: Integrated Product Development I (Vorlesung)

Lecturer:
Prof. Dieter Krause

Language:
DE

Cycle:
SS

Content:

- Introduction to Integrated Product Development
- 3D CAD -Systems and CAD interfaces
- Administration of part lists / PDM systems
- PDM in different industries
- Selection of CAD-/PDM Systems
- Simulation
- Construction methods
- Design for X

Literature:

- Ehrlenspiel, K.: Integrierte Produktentwicklung, München, Carl Hanser Verlag
- Lee, K.: Principles of CAD / CAM / CAE Systems, Addison Wesles
- Schichtel, M.: Produktdatenmodellierung in der Praxis, München, Carl Hanser Verlag
- Anderl, R.: CAD Schnittstellen, München, Carl Hanser Verlag
- Spur, G., Krause, F.: Das virtuelle Produkt, München, Carl Hanser Verlag

Focus Theoretical Mechanical Engineering

Module: Advanced Mechanical Engineering Design

Courses:

Title	Typ	Hrs/wk
Advanced Mechanical Engineering Design II	Vorlesung	2
Advanced Mechanical Engineering Design II	Hörsaalübung	2
Advanced Mechanical Engineering Design I	Vorlesung	2
Advanced Mechanical Engineering Design I	Hörsaalübung	2

Module Responsibility:
Prof. Dieter Krause

Admission Requirements:
None

Recommended Previous Knowledge:

- Fundamentals of Mechanical Engineering Design
- Mechanics
- Fundamentals of Materials Science
- Production Engineering

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
After passing the module, students are able to:

- explain complex working principles and functions of machine elements and of basic elements of fluidics,
- explain requirements, selection criteria, application scenarios and practical examples of complex machine elements,
- indicate the background of dimensioning calculations.

Capabilities:
After passing the module, students are able to:

- accomplish dimensioning calculations of covered machine elements,
- transfer knowledge learned in the module to new requirements and tasks (problem solving skills),
- recognize the content of technical drawings and schematic sketches,
- evaluate complex designs, technically.

Personal Competence:
Social Competence:

- Students are able to discuss technical information in the lecture supported by activating methods.

Autonomy:

- Students are able to independently deepen their acquired knowledge in exercises.
- Students are able to acquire additional knowledge and to recapitulate poorly understood content e.g. by using the video recordings of the lectures.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 68, Study Time in Lecture: 112

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Energy Systems: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Aircraft Systems Engineering: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Materials in Engineering Sciences: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Mechatronics: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Product Development and Production: Compulsory

General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Theoretical Mechanical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Energy Systems: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Aircraft Systems Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Materials in Engineering Sciences: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Mechatronics: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Product Development and Production: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Theoretical Mechanical Engineering: Compulsory
Mechanical Engineering: Kernqualifikation: Compulsory
Naval Architecture: Kernqualifikation: Compulsory

Course: Advanced Mechanical Engineering Design II (Vorlesung)

Lecturer:
Prof. Dieter Krause, Prof. Otto von Estorff

Language:
DE

Cycle:
SS

Content:
Advanced Mechanical Engineering Design I & II
Lecture

- Fundamentals of the following machine elements:
  - Linear rolling bearings
  - Axes & shafts
  - Seals
  - Clutches & brakes
  - Belt & chain drives
  - Gear drives
  - Epicyclic gears
  - Crank drives
  - Sliding bearings
- Elements of fluidics

Exercise

- Calculation methods of the following machine elements:
  - Linear rolling bearings
  - Axes & shafts
  - Clutches & brakes
  - Belt & chain drives
  - Gear drives
  - Epicyclic gears
  - Crank gears
  - Sliding bearings
- Calculations of hydrostatic systems (fluidics)

Literature:

- Dubbel, Taschenbuch für den Maschinenbau; Grote, K.-H., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.
- Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.
- Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.
- Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.
- Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.
- Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.
- Maschinenelemente – Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.
- Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.

Sowie weitere Bücher zu speziellen Themen

Course: Advanced Mechanical Engineering Design II (Übung)

Lecturer:
Prof. Dieter Krause, Prof. Otto von Estorff

Language:
DE

Cycle:
SS

Content:
Advanced Mechanical Engineering Design I & II
Lecture

- Fundamentals of the following machine elements:
  - Linear rolling bearings
  - Axes & shafts
  - Seals
  - Clutches & brakes
  - Belt & chain drives
  - Gear drives
  - Epicyclic gears
  - Crank drives
  - Sliding bearings
- Elements of fluidics

Exercise

- Calculation methods of the following machine elements:
  - Linear rolling bearings
  - Axes & shafts
  - Clutches & brakes
  - Belt & chain drives
  - Gear drives
  - Epicyclic gears
  - Crank gears
  - Sliding bearings
- Calculations of hydrostatic systems (fluidics)

Literature:

- Dubbel, Taschenbuch für den Maschinenbau; Grote, K.-H., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.
- Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.
- Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.
- Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.
- Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.
- Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.
- Maschinenelemente – Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.
- Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.

Sowie weitere Bücher zu speziellen Themen

Course: Advanced Mechanical Engineering Design I (Vorlesung)

Lecturer:
Prof. Dieter Krause, Prof. Otto von Estorff

Language:
DE

Cycle:
WS

Content:
Advanced Mechanical Engineering Design I & II
Lecture

- Fundamentals of the following machine elements:
  - Linear rolling bearings
  - Axes & shafts
  - Seals
  - Clutches & brakes
  - Belt & chain drives
  - Gear drives
  - Epicyclic gears
  - Crank drives
  - Sliding bearings
- Elements of fluidics

Exercise

- Calculation methods of the following machine elements:

  - Linear rolling bearings
  - Axes & shafts
  - Clutches & brakes
  - Belt & chain drives
  - Gear drives
  - Epicyclic gears
  - Crank gears
  - Sliding bearings
- Calculations of hydrostatic systems (fluidics)

Literature:

- Dubbel, Taschenbuch für den Maschinenbau; Grote, K.-H., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.
- Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.
- Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.
- Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.
- Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.
- Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.
- Maschinenelemente – Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.
- Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.

Sowie weitere Bücher zu speziellen Themen

Course: Advanced Mechanical Engineering Design I (Übung)

Lecturer:
Prof. Dieter Krause, Prof. Otto von Estorff

Language:
DE

Cycle:
WS

Content:
Advanced Mechanical Engineering Design I & II
Lecture

- Fundamentals of the following machine elements:
  - Linear rolling bearings
  - Axes & shafts
  - Seals
  - Clutches & brakes
  - Belt & chain drives
  - Gear drives
  - Epicyclic gears
  - Crank drives
  - Sliding bearings
- Elements of fluidics

Exercise

- Calculation methods of the following machine elements:
  - Linear rolling bearings
  - Axes & shafts
  - Clutches & brakes
  - Belt & chain drives
  - Gear drives
  - Epicyclic gears
  - Crank gears
  - Sliding bearings
- Calculations of hydrostatic systems (fluidics)

Literature:

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- Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.
- Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.
- Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.
- Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.
- Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.
- Maschinenelemente – Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.
- Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.

Sowie weitere Bücher zu speziellen Themen

Courses:

Title	Typ	Hrs/wk
Simulation of Dynamic Systems	Vorlesung	2
Simulation of Dynamic Systems	Gruppenübung	1
Reliability of Dynamic Systems	Vorlesung	2
Reliability of Dynamic Systems	Gruppenübung	1

Module Responsibility:
Prof. Uwe Weltin

Admission Requirements:

Recommended Previous Knowledge:
Fundatmentals of mechanics, control theory and electrical engineering

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students are able to describe methods and calculations for modeling, simulation and optimization of complex mechanical systems.
Capabilities:
Students are able to apply modern algorithms for modeling of mechanical systems.

Personal Competence:
Social Competence:
Students are able to work goal-oriented in small mixed groups.
Autonomy:
Students are able to recognize and improve knowledge deficits independently.
With instructor assistance, students are able to evaluate their own knowledge level and define a further course of study.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 96, Study Time in Lecture: 84

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Aircraft Systems Engineering: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Mechatronics: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Theoretical Mechanical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Aircraft Systems Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Mechatronics: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Theoretical Mechanical Engineering: Compulsory
Mechanical Engineering: Vertiefung Aircraft Systems Engineering: Compulsory
Mechanical Engineering: Vertiefung Theoretical Mechanical Engineering: Compulsory
Mechanical Engineering: Vertiefung Mechatronics: Compulsory
Mechatronics: Kernqualifikation: Compulsory

Course: Simulation of Dynamic Systems (Vorlesung)

Lecturer:
Prof. Uwe Weltin

Language:
DE

Cycle:
WS

Content:
Modeling
Model Identifikation
Numerical Methods in simulation
Applications and examples in Matlab® and Simulink®

Literature:
Skript zur Veranstaltung
Weitere Literatur in der Veranstaltung

Course: Simulation of Dynamic Systems (Übung)

Lecturer:
Prof. Uwe Weltin

Language:
DE

Cycle:
WS

Content:
Modeling
Model Identifikation
Numerical Methods in simulation
Applications and examples in Matlab® and Simulink®

Literature:
Skript zur Veranstaltung
Weitere Literatur in der Veranstaltung

Course: Reliability of Dynamic Systems (Vorlesung)

Lecturer:
Prof. Uwe Weltin

Language:
DE

Cycle:
WS

Content:
Methods for prediction and validation of life cycle of components and systems
Modeling, simulation, parameter identificaiton
Load data analysis and damage accumulation
Fatigue testing

Literature:
Bertsche, B.: Reliability in Automotive and Mechanical Engineering. Springer, 2008. ISBN: 978-3-540-33969-4
Inman, Daniel J.: Engineering Vibration. Prentice Hall, 3rd Ed., 2007. ISBN-13: 978-0132281737
Dresig, H., Holzweißig, F.: Maschinendynamik, Springer Verlag, 9. Auflage, 2009. ISBN 3540876936.
VDA (Hg.): Zuverlässigkeitssicherung bei Automobilherstellern und Lieferanten. Band 3 Teil 2, 3. überarbeitete Auflage, 2004. ISSN 0943-9412

Course: Reliability of Dynamic Systems (Übung)

Lecturer:
Prof. Uwe Weltin

Language:
DE

Cycle:
WS

Content:
Methods for prediction and validation of life cycle of components and systems
Modeling, simulation, parameter identificaiton
Load data analysis and damage accumulation
Fatigue testing

Literature:
Bertsche, B.: Reliability in Automotive and Mechanical Engineering. Springer, 2008. ISBN: 978-3-540-33969-4
Inman, Daniel J.: Engineering Vibration. Prentice Hall, 3rd Ed., 2007. ISBN-13: 978-0132281737
Dresig, H., Holzweißig, F.: Maschinendynamik, Springer Verlag, 9. Auflage, 2009. ISBN 3540876936.
VDA (Hg.): Zuverlässigkeitssicherung bei Automobilherstellern und Lieferanten. Band 3 Teil 2, 3. überarbeitete Auflage, 2004. ISSN 0943-9412

Courses:

Title	Typ	Hrs/wk
Advanced Mechanical Design Project	Testat	4

Module Responsibility:
Prof. Dieter Krause

Admission Requirements:
None

Recommended Previous Knowledge:

- Mechanical Engineering: Design
- Advanced Mechanical Engineering Design

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
After passing the module, students are able to:

- express the procedure for systematically handling of
- complex design tasks ,
- describe working principles, their use and combination possibilities,
- explain guidelines for designing for function and manufacturing,
- explain advanced use-oriented knowledge of machine elements.

Capabilities:
After passing the module, students are able to:

- analyze complex tasks and develop principle solutions using sketches,
- convert principle solutions into a detailed design,
- use methods to design and solve engineering design tasks systematically and solution-oriented,
- create a technical documentation including all necessary technical drawings to understand the functions of the system,
- document calculations of selected machine elements clearly and in detail.

Personal Competence:
Social Competence:
After passing the module, students are able to:

- present and discuss solutions and technical drawings within groups,
- reflect the own results in the work groups of the course

Autonomy:
After passing the module, students are able to:

- independently solve complex design projects, while motivating themselves, acquiring necessary knowledge and selecting appropriate methods,
- to independently solve problems.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Aircraft Systems Engineering: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Product Development and Production: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Theoretical Mechanical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Aircraft Systems Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Product Development and Production: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Theoretical Mechanical Engineering: Compulsory

Course: Advanced Mechanical Design Project (Testat)

Lecturer:
Prof. Dieter Krause, Prof. Otto von Estorff, Dr. Jens Schmidt, Dr. Volkert Wollesen

Language:
DE

Cycle:
WS

Content:
Das Konstruktionsprojekt gliedert sich in den Entwurf eines Getriebes sowie die Lösungsfindung.

- Getriebekonstruktion in Einzelarbeit
  - Erarbeitung von Lösungsprinzipien
  - Berechnung von Maschinenelementen
  - Entwurf eines Getriebes im Hauptschnitt plus allen Außenansichten
  - Erstellung einer ausführlichen Dokumentation
- Lösungsfindung
  - Methodische Erarbeitung von prinzipiellen Lösungskonzepten
  - Erstellen einer Dokumentation

Literature:

- Dubbel, Taschenbuch für den Maschinenbau; Grote, K.-H., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.
- Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.
- Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.
- Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.
- Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.
- Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.
- Maschinenelemente – Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.
- Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.
- Sowie weitere Bücher zu speziellen Themen

Module: Heat Transfer

Courses:

Title	Typ	Hrs/wk
Heat Transfer	Vorlesung	3
Heat Transfer	Hörsaalübung	1

Module Responsibility:
Prof. Heinz Herwig

Admission Requirements:
none

Recommended Previous Knowledge:
Technical Thermodynamics I, II and Fluid Dynamics

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students are able to
- describe the different physical mechanism of Heat Transfer,
- explain the technical terms,
- to analyse comlex heat transfer processes in a critical way.

Capabilities:
The students are able to
- understand the physics of Heat Transfer,
- calculate and evaluate complex Heat Transfer processes,
- solve excersises self-consistent and in small groups.

Personal Competence:
Social Competence:
The students are able to discuss in small groups and develop an approach.
Autonomy:
The students are able to develop a complex problem self-consistent and analyse the results in a critical way. A qualified exchange with other students is given.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Biomechanics: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Energy Systems: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Theoretical Mechanical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Biomechanics: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Energy Systems: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Theoretical Mechanical Engineering: Compulsory
Mechanical Engineering: Vertiefung Energy Systems: Compulsory
Mechanical Engineering: Vertiefung Theoretical Mechanical Engineering: Compulsory

Course: Heat Transfer (Vorlesung)

Lecturer:
Prof. Heinz Herwig

Language:
DE

Cycle:
WS

Content:
Dimensional analysis, heat conduction, convective heat transfer, Two- phase heat transfer (evaporation, condensation), thermal radiation, heat exchangers, measurement methods

Literature:

- Herwig, H.; Moschallski, A.: Wärmeübertragung, 2. Auflage, Vieweg+Teubner Verlag, Wiesbaden, 2009
- Herwig, H.: Wärmeübertragung von A-Z, Springer- Verlag, Berlin, Heidelberg, 2000
- Baehr, H.D.; Stephan, K.: Wärme- und Stoffübertragung, 2. Auflage, Springer Verlag, Berlin, Heidelberg, 1996

Course: Heat Transfer (Übung)

Lecturer:
Prof. Heinz Herwig

Language:
DE

Cycle:
WS

Content:
Dimensional analysis, heat conduction, convective heat transfer, Two- phase heat transfer (evaporation, condensation), thermal radiation, heat exchangers, measurement methods

Literature:

- Herwig, H.; Moschallski, A.: Wärmeübertragung, 2. Auflage, Vieweg+Teubner Verlag, Wiesbaden, 2009
- Herwig, H.: Wärmeübertragung von A-Z, Springer- Verlag, Berlin, Heidelberg, 2000
- Baehr, H.D.; Stephan, K.: Wärme- und Stoffübertragung, 2. Auflage, Springer Verlag, Berlin, Heidelberg, 1996

Courses:

Title	Typ	Hrs/wk
Differential Equations 2 (Partial Differential Equations)	Vorlesung	2
Differential Equations 2 (Partial Differential Equations)	Gruppenübung	1
Differential Equations 2 (Partial Differential Equations)	Hörsaalübung	1
Complex Functions	Vorlesung	2
Complex Functions	Gruppenübung	1
Complex Functions	Hörsaalübung	1

Module Responsibility:
Prof. Anusch Taraz

Admission Requirements:
none

Recommended Previous Knowledge:
Mathematics 1 - III

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:

- Students can name the basic concepts in Mathematics IV. They are able to explain them using appropriate examples.
- Students can discuss logical connections between these concepts. They are capable of illustrating these connections with the help of examples.
- They know proof strategies and can reproduce them.

Capabilities:

- Students can model problems in Mathematics IV with the help of the concepts studied in this course. Moreover, they are capable of solving them by applying established methods.
- Students are able to discover and verify further logical connections between the concepts studied in the course.
- For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results.

Personal Competence:
Social Competence:

- Students are able to work together in teams. They are capable to use mathematics as a common language.
- In doing so, they can communicate new concepts according to the needs of their cooperating partners. Moreover, they can design examples to check and deepen the understanding of their peers.

Autonomy:

- Students are capable of checking their understanding of complex concepts on their own. They can specify open questions precisely and know where to get help in solving them.
- Students have developed sufficient persistence to be able to work for longer periods in a goal-oriented manner on hard problems.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 68, Study Time in Lecture: 112

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Electrical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Mechatronics: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Theoretical Mechanical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Naval Architecture: Compulsory
Computer Science: Vertiefung Computational Mathematics: Compulsory suffrage
Electrical Engineering: Kernqualifikation: Compulsory

Electrical Engineering myTrack: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Electrical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Naval Architecture: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Mechatronics: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Theoretical Mechanical Engineering: Compulsory
Computational Science and Engineering: Vertiefung Engineering Sciences: Compulsory suffrage
Mechanical Engineering: Vertiefung Theoretical Mechanical Engineering: Compulsory
Mechanical Engineering: Vertiefung Mechatronics: Compulsory
Mechatronics: Kernqualifikation: Compulsory
Naval Architecture: Kernqualifikation: Compulsory

Course: Differential Equations 2 (Partial Differential Equations) (Vorlesung)

Lecturer:
Dozenten des Fachbereiches Mathematik der UHH

Language:
DE

Cycle:
SS

Content:
Main features of the theory and numerical treatment of partial differential equations

- Examples of partial differential equations
- First order quasilinear differential equations
- Normal forms of second order differential equations
- Harmonic functions and maximum principle
- Maximum principle for the heat equation
- Wave equation
- Liouville's formula
- Special functions
- Difference methods
- Finite elements

Literature:

- R. Ansorge, H. J. Oberle: Mathematik für Ingenieure, Band 2; Verlag Wiley-VCH, Berlin, Weinheim, New York, 2000
- P. Henrici, R. Jelsch: Komplexe Analysis für Ingenieure, Birkhäuser Verlag, Basel, 1998
- A. Tveito, R. Winther: Einführung in partielle Differentialgleichungen, Springer Verlag, Berlin, Heidelberg, New York, 2002

Course: Differential Equations 2 (Partial Differential Equations) (Übung)

Lecturer:
Dozenten des Fachbereiches Mathematik der UHH

Language:
DE

Cycle:
SS

Content:
Main features of the theory and numerical treatment of partial differential equations

- Examples of partial differential equations
- First order quasilinear differential equations
- Normal forms of second order differential equations
- Harmonic functions and maximum principle
- Maximum principle for the heat equation
- Wave equation
- Liouville's formula
- Special functions
- Difference methods
- Finite elements

Literature:

- R. Ansorge, H. J. Oberle: Mathematik für Ingenieure, Band 2; Verlag Wiley-VCH, Berlin, Weinheim, New York, 2000
- P. Henrici, R. Jelsch: Komplexe Analysis für Ingenieure, Birkhäuser Verlag, Basel, 1998
- A. Tveito, R. Winther: Einführung in partielle Differentialgleichungen, Springer Verlag, Berlin, Heidelberg, New York, 2002

Course: Differential Equations 2 (Partial Differential Equations) (Ubung)

Lecturer:
Dozenten des Fachbereiches Mathematik der UHH

Language:
DE

Cycle:
SS

Content:
Main features of the theory and numerical treatment of partial differential equations

- Examples of partial differential equations
- First order quasilinear differential equations
- Normal forms of second order differential equations
- Harmonic functions and maximum principle
- Maximum principle for the heat equation
- Wave equation
- Liouville's formula
- Special functions
- Difference methods
- Finite elements

Literature:

- R. Ansorge, H. J. Oberle: Mathematik für Ingenieure, Band 2; Verlag Wiley-VCH, Berlin, Weinheim, New York, 2000
- P. Henrici, R. Jelsch: Komplexe Analysis für Ingenieure, Birkhäuser Verlag, Basel, 1998
- A. Tveito, R. Winther: Einführung in partielle Differentialgleichungen, Springer Verlag, Berlin, Heidelberg, New York, 2002

Course: Complex Functions (Vorlesung)

Lecturer:
Dozenten des Fachbereiches Mathematik der UHH

Language:
DE

Cycle:
SS

Content:
Main features of complex analysis

- Functions of one complex variable
- Complex differentiation
- Conformal mappings
- Complex integration
- Cauchy's integral theorem
- Cauchy's integral formula
- Taylor and Laurent series expansion
- Singularities and residuals
- Integral transformations: Fourier and Laplace transformation

Literature:

- R. Ansorge, H. J. Oberle: Mathematik für Ingenieure, Band 2; Verlag Wiley-VCH, Berlin, Weinheim, New York, 2000
- P. Henrici, R. Jelsch: Komplexe Analysis für Ingenieure, Birkhäuser Verlag, Basel, 1998

Course: Complex Functions (Übung)

Lecturer:
Dozenten des Fachbereiches Mathematik der UHH

Language:
DE

Cycle:
SS

Content:
Main features of complex analysis

- Functions of one complex variable
- Complex differentiation
- Conformal mappings

- Complex integration
- Cauchy's integral theorem
- Cauchy's integral formula
- Taylor and Laurent series expansion
- Singularities and residuals
- Integral transformations: Fourier and Laplace transformation

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- R. Ansorge, H. J. Oberle: Mathematik für Ingenieure, Band 2; Verlag Wiley-VCH, Berlin, Weinheim, New York, 2000
- P. Henrici, R. Jelsch: Komplexe Analysis für Ingenieure, Birkhäuser Verlag, Basel, 1998

Course: Complex Functions (Übung)

Lecturer:
Dozenten des Fachbereiches Mathematik der UHH

Language:
DE

Cycle:
SS

Content:
Main features of complex analysis

- Functions of one complex variable
- Complex differentiation
- Conformal mappings
- Complex integration
- Cauchy's integral theorem
- Cauchy's integral formula
- Taylor and Laurent series expansion
- Singularities and residuals
- Integral transformations: Fourier and Laplace transformation

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- R. Ansorge, H. J. Oberle: Mathematik für Ingenieure, Band 2; Verlag Wiley-VCH, Berlin, Weinheim, New York, 2000
- P. Henrici, R. Jelsch: Komplexe Analysis für Ingenieure, Birkhäuser Verlag, Basel, 1998

Specialisation Biomedical Engineering

Module: Fundamentals of Materials Science

Courses:

Title	Typ	Hrs/wk
Fundamentals of Materials Science I	Vorlesung	2
Fundamentals of Materials Science II (Advanced Ceramic Materials, Polymers and Composites)	Vorlesung	2
Physical and Chemical Basics of Materials Science	Vorlesung	2

Module Responsibility:
Prof. Jörg Weißmüller

Admission Requirements:
None

Recommended Previous Knowledge:
Highschool-level physics, chemistry und mathematics

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students have acquired a fundamental knowledge on metals, ceramics and polymers and can describe this knowledge comprehensively. Fundamental knowledge here means specifically the issues of atomic structure, microstructure, phase diagrams, phase transformations, corrosion and mechanical properties. The students know about the key aspects of characterization methods for materials and can identify relevant approaches for characterizing specific properties. They are able to trace materials phenomena back to the underlying physical and chemical laws of nature.

Capabilities:
The students are able to trace materials phenomena back to the underlying physical and chemical laws of nature. Materials phenomena here refers to mechanical properties such as strength, ductility, and stiffness, chemical properties such as corrosion resistance, and to phase transformations such as solidification, precipitation, or melting. The students can explain the relation between processing conditions and the materials microstructure, and they can account for the impact of microstructure on the material's behavior.

Personal Competence:
Social Competence:
-
Autonomy:
-

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 96, Study Time in Lecture: 84

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Naval Architecture: Compulsory
Energy and Environmental Engineering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Naval Architecture: Compulsory
Logistics and Mobility: Vertiefung Engineering Science: Compulsory suffrage
Mechanical Engineering: Kernqualifikation: Compulsory
Mechatronics: Kernqualifikation: Compulsory
Naval Architecture: Kernqualifikation: Compulsory
Technomathematics: Vertiefung Engineering Science: Compulsory suffrage

Course: Fundamentals of Materials Science I (Vorlesung)

Lecturer:
Prof. Jörg Weißmüller

Language:
DE

Cycle:
WS

Content:

Literature:
Vorlesungsskript
W.D. Callister: Materials Science and Engineering - An Introduction. 5th ed., John Wiley & Sons, Inc., New York, 2000, ISBN 0-471-32013-7

Course: Fundamentals of Materials Science II (Advanced Ceramic Materials, Polymers and Composites) (Vorlesung)

Lecturer:
Prof. Bodo Fiedler, Prof. Gerold Schneider

Language:
DE

Cycle:
SS

Content:
Chemische Bindungen und Aufbau von Festkörpern; Kristallaufbau; Werkstoffprüfung; Schweißbarkeit; Herstellung von Keramiken; Aufbau und Eigenschaften der Keramik; Herstellung, Aufbau und Eigenschaften von Gläsern; Polymerwerkstoffe, Makromolekularer Aufbau; Struktur und Eigenschaften der Polymere; Polymerverarbeitung; Verbundwerkstoffe

Literature:
Vorlesungsskript
W.D. Callister: Materials Science and Engineering -An Introduction-5th ed., John Wiley & Sons, Inc., New York, 2000, ISBN 0-471-32013-7

Course: Physical and Chemical Basics of Materials Science (Vorlesung)

Lecturer:
Prof. Stefan Müller

Language:
DE

Cycle:
WS

Content:

Literature:
Für den **Elektromagnetismus:**

- Bergmann-Schäfer: „Lehrbuch der Experimentalphysik“, Band 2: „Elektromagnetismus“, de Gruyter

Für die **Atomphysik:**

- Haken, Wolf: „Atom- und Quantenphysik“, Springer

Für die **Materialphysik und Elastizität:**

- Hornbogen, Warlimont: „Metallkunde“, Springer

Module: Introduction into Medical Technology and Systems

Courses:

Title	Typ	Hrs/wk
Introduction into Medical Technology and Systems	Vorlesung	2
Introduction into Medical Technology and Systems	Problemorientierte Lehrveranstaltung	4

Module Responsibility:
Prof. Alexander Schlaefer

Admission Requirements:

Recommended Previous Knowledge:
principles of math (algebra, analysis/calculus)
principles of stochastics
principles of programming, R/Matlab

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students can explain medical technology and its principles, including imaging systems, computer aided surgery, medical sensor systems, medical information systems. They are able to give an overview of regulatory affairs and standards in medical technology.
Capabilities:
The students are able to apply principles of medical technology to solving actual problems.

Personal Competence:
Social Competence:
The students describe a problem in medical technology as a project, and define tasks that are solved in a joint effort.
Autonomy:
The students can reflect their knowledge and document the results of their work. They can present the results in an appropriate manner.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 96, Study Time in Lecture: 84

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Biomedical Engineering: Compulsory
Computer Science: Vertiefung Computer Engineering: Compulsory suffrage
Electrical Engineering: Kernqualifikation: Compulsory suffrage
Electrical Engineering myTrack: Kernqualifikation: Compulsory suffrage
General Engineering Science (English program): Vertiefung Biomedical Engineering: Compulsory
Technomathematics: Vertiefung Engineering Science: Compulsory suffrage

Course: Introduction into Medical Technology and Systems (Vorlesung)

Lecturer:
Prof. Alexander Schlaefer

Language:
DE

Cycle:
SS

Content:
- imaging systems
- computer aided surgery
- medical sensor systems
- medical information systems
- regulatory affairs
- standard in medical technology

The students will work in groups to apply the methods introduced during the lecture using problem based learning.

Literature:
Wird in der Veranstaltung bekannt gegeben.

Course: Introduction into Medical Technology and Systems (Problemorientierte Lehrveranstaltung)

Lecturer:
Prof. Alexander Schlaefer

Language:
DE

Cycle:
SS

Content:
- imaging systems
- computer aided surgery
- medical sensor systems
- medical information systems
- regulatory affairs
- standard in medical technology

The students will work in groups to apply the methods introduced during the lecture using problem based learning.

Literature:
Wird in der Veranstaltung bekannt gegeben.

Courses:

Title	Typ	Hrs/wk
Introduction to Anatomy	Vorlesung	2
Introduction to Radiology and Radiation Therapy	Vorlesung	2

Module Responsibility:
Prof. Michael Morlock

Admission Requirements:
None

Recommended Previous Knowledge:

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Therapy
The students can distinguish different types of currently used equipment with respect to its use in radiation therapy.
The students can explain complex treatment plans used in radiation therapy in interdisciplinary contexts (e.g. surgery, internal medicine).
The students can describe the patients' passage from their initial admittance through to follow-up care.
Diagnostics
The students can illustrate the technical base concepts of projection radiography, including angiography and mammography, as well as sectional imaging techniques (CT, MRT, US).
The students can explain the diagnostic as well as therapeutic use of imaging techniques, as well as the technical basis for those techniques.
The students can choose the right treatment method depending on the patient's clinical history and needs.
The student can explain the influence of technical errors on the imaging techniques.
The student can draw the right conclusions based on the images' diagnostic findings or the error protocol.
Anatomy
The students can describe
basal structures and functions of internal organs and the musculoskeletal system
.
The students can describe the basic macroscopy and microscopy of those systems.
Capabilities:
Therapy
The students can distinguish curative and palliative situations and motivate why they came to that conclusion.
The students can develop adequate therapy concepts and relate it to the radiation biological aspects.
The students can use the therapeutic principle (effects vs adverse effects)
The students can distinguish different kinds of radiation, can choose the best one depending on the situation (location of the tumor) and choose the energy needed in that situation (irradiation planning).
The student can assess what an individual psychosocial service should look like (e.g. follow-up treatment, sports, social help groups, self-help groups, social services, psycho-oncology).
Diagnostics
The students can suggest solutions for repairs of imaging instrumentation after having done error analyses.
The students can classify results of imaging techniques according to different groups of diseases based on their knowledge of anatomy, pathology and pathophysiology.
Anatomy
The students can recognize the relationship between given anatomical facts and the development of common diseases; they can explain the relevance of structures and their functions in the context of widespread diseases.

Personal Competence:
Social Competence:
The students can assess the special social situation of tumor patients and interact with them in a professional way.
The students are aware of the special, often fear-dominated behavior of sick people caused by diagnostic and therapeutic measures and can meet them appropriately.
The students can participate in current discussions in biomedical research and medicine on a professional level.
Autonomy:
The students can apply their new knowledge and skills to a concrete therapy case.
The students can introduce younger students to the clinical daily routine.
The students are able to access anatomical knowledge by themselves, can participate competently in conversations on the topic and acquire the relevant knowledge themselves.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:

General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Biomechanics: Compulsory
General Engineering Science (German program): Vertiefung Biomedical Engineering: Compulsory
Electrical Engineering: Vertiefung Medical Technology: Compulsory suffrage
General Engineering Science (English program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Biomechanics: Compulsory
Mechanical Engineering: Vertiefung Biomechanics: Compulsory
Technomathematics: Vertiefung Engineering Science: Compulsory suffrage

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Course: Introduction to Anatomy (Vorlesung)

Lecturer:
Prof. Udo Schumacher

Language:
DE

Cycle:
SS

Content:

General Anatomy

1st week:	**The Eucaryote Cell**
2nd week:	**The Tissues**
3rd week:	**Cell Cycle, Basics in Development**
4th week:	**Musculoskeletal System**
5th week:	**Cardiovascular System**
6th week:	**Respiratory System**
7th week:	**Genito-urinary System**
8th week:	**Immune system**
9th week:	**Digestive System I**
10th week:	**Digestive System II**
11th week:	**Endocrine System**
12th week:	**Nervous System**
13th week:	**Exam**

Literature:
Adolf Faller/Michael Schünke, Der Körper des Menschen, 16. Auflage, Thieme Verlag Stuttgart, 2012

Course: Introduction to Radiology and Radiation Therapy (Vorlesung)

Lecturer:
Prof. Ulrich Carl, Prof. Thomas Vestring

Language:
DE

Cycle:
SS

Content:
The students will be given an understanding of the technological possibilities in the field of medical imaging, interventional radiology and radiation therapy/radiation oncology. It is assumed, that students in the beginning of the course have heard the word “X-ray” at best. It will be distinguished between the two arms of diagnostic (Prof. Dr. med. Thomas Vestring) and therapeutic (Prof. Dr. med. Ulrich Carl) use of X-rays. Both arms depend on special big units, which determine a predefined sequence in their respective departments

Literature:

- "Technik der medizinischen Radiologie" von T. + J. Laubenberg –
  7. Auflage – Deutscher Ärzteverlag – erschienen 1999
- "Klinische Strahlenbiologie" von Th. Herrmann, M. Baumann und W. Dörr –
  4. Auflage - Verlag Urban & Fischer – erschienen 02.03.2006
  ISBN: 978-3-437-23960-1
- "Strahlentherapie und Onkologie für MTA-R" von R. Sauer –
  5. Auflage 2003 - Verlag Urban & Schwarzenberg – erschienen 08.12.2009
  ISBN: 978-3-437-47501-6

- "Taschenatlas der Physiologie" von S. Silbernagel und A. Despopoulus
  8. Auflage – Georg Thieme Verlag - erschienen 19.09.2012
  ISBN: 978-3-13-567708-8

- "Der Körper des Menschen " von A. Faller u. M. Schünke -
  16. Auflage 2004 – Georg Thieme Verlag – erschienen 18.07.2012
  ISBN: 978-3-13-329716-5

- „Praxismanual Strahlentherapie“ von Stöver / Feyer –
  1. Auflage - Springer-Verlag GmbH – erschienen 02.06.2000

Module: Signals and Systems

Courses:

Title	Typ	Hrs/wk
Signals and Systems	Vorlesung	3
Signals and Systems	Hörsaalübung	1

Module Responsibility:
Prof. Gerhard Bauch

Admission Requirements:
Mathematics 1-3

Recommended Previous Knowledge:

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students are able to classify and describe signals and linear time-invariant (LTI) systems using methods of signal and system theory. They are able to apply the fundamental transformations of continuous-time and discrete-time signals and systems. They can describe and analyse deterministic signals and systems mathematically in both time and image domain. In particular, they understand the effects in time domain and image domain which are caused by the transition of a continuous-time signal to a discrete-time signal.
Capabilities:
The students are able to describe and analyse deterministic signals and linear time-invariant systems using methods of signal and system theory. They can analyse and design basic systems regarding important properties such as magnitude and phase response, stability, linearity etc.. They can assess the impact of LTI systems on the signal properties in time and frequency domain.

Personal Competence:
Social Competence:
The students can jointly solve specific problems.
Autonomy:
The students are able to acquire relevant information from appropriate literature sources. They can control their level of knowledge during the lecture period by solving tutorial problems, software tools, clicker system.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Electrical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Computer Science and Engineering: Compulsory
General Engineering Science (German program): Vertiefung Chemical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (German program): Vertiefung Civil- and Enviromental Engeneering: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Biomedical Engineering: Compulsory
Computer Science: Kernqualifikation: Compulsory
Electrical Engineering: Kernqualifikation: Compulsory
Electrical Engineering myTrack: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Civil- and Enviromental Engeneering: Compulsory
General Engineering Science (English program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (English program): Vertiefung Electrical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Computer Science and Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Chemical Engineering: Compulsory
Computational Science and Engineering: Kernqualifikation: Compulsory
Mechatronics: Kernqualifikation: Compulsory
Technomathematics: Vertiefung Engineering Science: Compulsory suffrage

Course: Signals and Systems (Vorlesung)

Lecturer:
Prof. Gerhard Bauch

Language:
DE/EN

Cycle:
SS

Content:

- Basic classification and description of continuous-time and discrete-time signals and systems
- Concvolution
- Power and energy of signals
- Correlation functions of deterministic signals
- Linear time-invariant (LTI) systems
- Signal transformations:
  - Fourier-Series
  - Fourier Transform
  - Laplace Transform
  - Discrete-time Fourier Transform
  - Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT)
  - Z-Transform
- Analysis and design of LTI systems in time and frequency domain
- Basic filter types
- Sampling, sampling theorem
- Fundamentals of recursive and non-recursive discrete-time filters

Literature:

- T. Frey , M. Bossert , Signal- und Systemtheorie, B.G. Teubner Verlag 2004
- K. Kammeyer, K. Kroschel, Digitale Signalverarbeitung, Teubner Verlag.
- B. Girod ,R. Rabensteiner , A. Stenger , Einführung in die Systemtheorie, B.G. Teubner, Stuttgart, 1997
- J.R. Ohm, H.D. Lüke , Signalübertragung, Springer-Verlag 8. Auflage, 2002
- S. Haykin, B. van Veen: Signals and systems. Wiley.
- Oppenheim, A.S. Willsky: Signals and Systems. Pearson.
- Oppenheim, R. W. Schafer: Discrete-time signal processing. Pearson.

Course: Signals and Systems (Übung)

Lecturer:
Prof. Gerhard Bauch

Language:
DE/EN

Cycle:
SS

Content:

- Basic classification and description of continuous-time and discrete-time signals and systems
- Concvolution
- Power and energy of signals
- Correlation functions of deterministic signals
- Linear time-invariant (LTI) systems
- Signal transformations:
  - Fourier-Series
  - Fourier Transform
  - Laplace Transform
  - Discrete-time Fourier Transform
  - Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT)
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- Basic filter types
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- T. Frey , M. Bossert , Signal- und Systemtheorie, B.G. Teubner Verlag 2004
- K. Kammeyer, K. Kroschel, Digitale Signalverarbeitung, Teubner Verlag.
- B. Girod ,R. Rabensteiner , A. Stenger , Einführung in die Systemtheorie, B.G. Teubner, Stuttgart, 1997
- J.R. Ohm, H.D. Lüke , Signalübertragung, Springer-Verlag 8. Auflage, 2002
- S. Haykin, B. van Veen: Signals and systems. Wiley.
- Oppenheim, A.S. Willsky: Signals and Systems. Pearson.
- Oppenheim, R. W. Schafer: Discrete-time signal processing. Pearson.

Module: Fluid Dynamics

Courses:

Title	Typ	Hrs/wk
Fluid Mechanics	Vorlesung	3
Fluid Mechanics	Hörsaalübung	1

Module Responsibility:
Prof. Heinz Herwig

Admission Requirements:
none

Recommended Previous Knowledge:
Technical Thermodynamics I, II

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students are able to
- distinguish the different physical mechanism of fluid dynamics,
- understand the different mathematic modeling of fluid flow,
- to apply and calculate fluid flow processes in different problems in nature and techniques.

Capabilities:
The students are able to
- understand the physics of Fluid Dynamics,
- calculate and evaluate complex Fluid Dynamics processes,
- solve excersises self-consistent and in small groups.

Personal Competence:
Social Competence:
The students are able to discuss in small groups and develop an approach.
Autonomy:
The students are able to develop a complex problem self-consistent and analyse the results in a critical way. A qualified exchange with other students is given.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Biomedical Engineering: Compulsory
Computational Science and Engineering: Vertiefung Engineering Sciences: Compulsory suffrage
Mechanical Engineering: Kernqualifikation: Compulsory

Course: Fluid Mechanics (Vorlesung)

Lecturer:
Prof. Heinz Herwig

Language:
DE

Cycle:
SS

Content:

- Overview
- Physical/mathematical modelling
- Special phenomena
- Basic equations of fluid dynamics
- The turbulence problem
- One dimensional theory for inkompressibel flows
- One dimensional theory for kompressibel flows
- Flow over contours without friction

- Flow over contours with friction
- Flow through channels
- Simplified equations for three dimensional flow
- Special aspects of the numerical solution for complex flows

Literature:

- Herwig, H.: Strömungsmechanik, 2. Auflage, Springer- Verlag, Berlin, Heidelberg, 2006
- Herwig, H.: Strömungsmechanik von A-Z, Vieweg Verlag, Wiesbaden, 2004

Course: Fluid Mechanics (Übung)

Lecturer:
Prof. Heinz Herwig

Language:
DE

Cycle:
SS

Content:

- Overview
- Physical/mathematical modelling
- Special phenomena
- Basic equations of fluid dynamics
- The turbulence problem
- One dimensional theory for inkompressibel flows
- One dimensional theory for kompressibel flows
- Flow over contours without friction
- Flow over contours with friction
- Flow through channels
- Simplified equations for three dimensional flow
- Special aspects of the numerical solution for complex flows

Literature:

- Herwig, H.: Strömungsmechanik, 2. Auflage, Springer- Verlag, Berlin, Heidelberg, 2006
- Herwig, H.: Strömungsmechanik von A-Z, Vieweg Verlag, Wiesbaden, 2004

Module: Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems)

Courses:

Title	Typ	Hrs/wk
Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems)	Vorlesung	3
Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems)	Gruppenübung	2
Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems)	Hörsaalübung	1

Module Responsibility:
NN

Admission Requirements:
none

Recommended Previous Knowledge:
Mechanics I (Statics) and Mechanics III (Hydrostatics, Kinematics, Dynamics)
Mathematics I and II

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students can

- describe the axiomatic procedure used in mechanical contexts;
- explain important steps in model design;
- present technical knowledge.

Capabilities:
The students can

- explain the important elements of mathematical / mechanical analysis and model formation, and apply it to the context of their own problems;
- apply basic methods to engineering problems;
- estimate the reach and boundaries of the methods and extend them to be applicable to wider problem sets.

Personal Competence:
Social Competence:
The students can work in groups and support each other to overcome difficulties.
Autonomy:
Students are capable of determining their own strengths and weaknesses and to organize their time and learning based on those.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 96, Study Time in Lecture: 84

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Naval Architecture: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Naval Architecture: Compulsory
Mechanical Engineering: Kernqualifikation: Compulsory
Mechatronics: Kernqualifikation: Compulsory
Naval Architecture: Kernqualifikation: Compulsory
Technomathematics: Kernqualifikation: Compulsory suffrage

Course: Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems) (Vorlesung)

Lecturer:
NN

Language:
DE

Cycle:

SS

Content:

- Simple impact problems
- Principles of analytical mechanics
- Elements of vibration theory
- Basics of continuum vibrations
- Introduction into Modeling of Multibody Systems

Literature:

K. Magnus, H.H. Müller-Slany: Grundlagen der Technischen Mechanik. 7. Auflage, Teubner (2009).
D. Gross, W. Hauger, J. Schröder, W. Wall: Technische Mechanik 1-4. 11. Auflage, Springer (2011).

Course: Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems) (Übung)

Lecturer:

NN

Language:

DE

Cycle:

SS

Content:

- Simple impact problems
- Principles of analytical mechanics
- Elements of vibration theory
- Basics of continuum vibrations
- Introduction into Modeling of Multibody Systems

Literature:

K. Magnus, H.H. Müller-Slany: Grundlagen der Technischen Mechanik. 7. Auflage, Teubner (2009).
D. Gross, W. Hauger, J. Schröder, W. Wall: Technische Mechanik 1-4. 11. Auflage, Springer (2011).

Course: Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems) (Übung)

Lecturer:

NN

Language:

DE

Cycle:

SS

Content:

- Simple impact problems
- Principles of analytical mechanics
- Elements of vibration theory
- Basics of continuum vibrations
- Introduction into Modeling of Multibody Systems

Literature:

K. Magnus, H.H. Müller-Slany: Grundlagen der Technischen Mechanik. 7. Auflage, Teubner (2009).
D. Gross, W. Hauger, J. Schröder, W. Wall: Technische Mechanik 1-4. 11. Auflage, Springer (2011).

Courses:

Title	Typ	Hrs/wk
Embodiment Design and 3D-CAD	Vorlesung	2
Mechanical Design Project I	Testat	3
Mechanical Design Project II	Testat	3
Team Project Design Methodology	Problemorientierte Lehrveranstaltung	2

Module Responsibility:
Prof. Dieter Krause

Admission Requirements:
None

Recommended Previous Knowledge:

- Fundamentals of Mechanical Engineering Design
- Mechanics
- Fundamentals of Materials Science
- Production Engineering

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
After passing the module, students are able to:

- explain design guidelines for machinery parts e.g. considering load situation, materials and manufacturing requirements,
- describe basics of 3D CAD,
- explain basics methods of engineering designing.

Capabilities:
After passing the module, students are able to:

- independently create sketches, technical drawings and documentations e.g. using 3D CAD,
- design components based on design guidelines autonomously,
- dimension (calculate) used components,
- use methods to design and solve engineering design tasks systamtically and solution-oriented,
- apply creativity techniques in teams.

Personal Competence:
Social Competence:
After passing the module, students are able to:

- develop and evaluate solutions in groups including making and documenting decisions,
- moderate the use of scientific methods,
- present and discuss solutions and technical drawings within groups,
- reflect the own results in the work groups of the course.

Autonomy:
Students are able

- to estimate their level of knowledge using activating methods within the lectures (e.g. with clickers),
- To solve engineering design tasks systematically.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 40, Study Time in Lecture: 140

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Biomedical Engineering: Compulsory
Energy and Environmental Engineering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Biomedical Engineering: Compulsory

Mechanical Engineering: Kernqualifikation: Compulsory
Mechatronics: Kernqualifikation: Compulsory
Naval Architecture: Kernqualifikation: Compulsory

Course: Embodiment Design and 3D-CAD (Vorlesung)

Lecturer:
Prof. Dieter Krause

Language:
DE

Cycle:
WS

Content:

- Basics of 3D CAD technology
- Practical course to apply a 3D CAD system
  - Introduction to the system
  - Sketching and creation of components
  - Creation of assemblies
  - Deriving technical drawings

Literature:

- CAx für Ingenieure eine praxisbezogene Einführung; Vajna, S., Weber, C., Bley, H., Zeman, K.; Springer-Verlag, aktuelle Auflage.
- Handbuch Konstruktion; Rieg, F., Steinhilper, R.; Hanser; aktuelle Auflage.
- Dubbel, Taschenbuch für den Maschinenbau; Grote, K.-H., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.
- Technisches Zeichnen: Grundlagen, Normen, Beispiele, Darstellende Geometrie, Hoischen, H; Hesser, W; Cornelsen, aktuelle Auflage.
- Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.
- Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.
- Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.
- Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.
- Maschinenelemente – Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.
- Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.

Course: Mechanical Design Project I (Testat)

Lecturer:
Prof. Thorsten Schüppstuhl

Language:
DE

Cycle:
WS

Content:

- Create a technical documentation of an existing mechanical model
- Consolidation of the following aspects of technical drawings:
  - Presentation of technical objects and standardized parts
    (bearings, seals, shaft-hub joints, detachable connections, springs, axes and shafts)
  - Sectional views
  - Dimensioning
  - Tolerances and surface specifications
  - Creating a tally sheet

Literature:

1. Hoischen, H.; Hesser, W.: Technisches Zeichnen. Grundlagen, Normen, Beispiele, darstellende Geometrie, 33. Auflage. Berlin 2011.
2. Labisch, S.; Weber, C.: Technisches Zeichnen. Selbstständig lernen und effektiv üben, 4. Auflage. Wiesbaden 2008.
3. Fischer, U.: Tabellenbuch Metall, 43. Auflage. Haan-Gruiten 2005.

Course: Mechanical Design Project II (Testat)

Lecturer:
Prof. Wolfgang Hintze

Language:

DE

Cycle:
SS

Content:

- Generation of sketches for functions and sub-functions
- Approximately calculation of shafts
- Dimension of bearings, screw connections and weld
- Generation of engineering drawings (assembly drawings, manufacturing drawing)

Literature:
Dubbel, Taschenbuch für Maschinenbau, Beitz, W., Küttner, K.-H, Springer-Verlag.
Maschinenelemente, Band I - III, Niemann, G., Springer-Verlag.
Maschinen- und Konstruktionselemente, Steinhilper, W., Röper, R., Springer-Verlag.
Einführung in die DIN-Normen, Klein, M., Teubner-Verlag.
Konstruktionslehre, Pahl, G., Beitz, W., Springer-Verlag.

Course: Team Project Design Methodology (Problemorientierte Lehrveranstaltung)

Lecturer:
Prof. Dieter Krause

Language:
DE

Cycle:
SS

Content:

- Introduction to engineering designing methodology
- Team Project Design Methodology
  - Creating requirement lists
  - Problem formulation
  - Creating functional structures
  - Finding solutions
  - Evaluation of the found concepts
  - Documentation of the taken methodological steps and the concepts using presentation slides

Literature:

- Dubbel, Taschenbuch für den Maschinenbau; Grote, K.-H., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.
- Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.
- Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.
- Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.
- Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.
- Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.
- Maschinenelemente – Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.
- Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.
- Sowie weitere Bücher zu speziellen Themen

Module: BIO I: Implants and Testing

Courses:

Title	Typ	Hrs/wk
Experimental Methods in Biomechanics	Nicht definiert	2
Implants and Fracture Healing	Vorlesung	2

Module Responsibility:
Prof. Michael Morlock

Admission Requirements:
None

Recommended Previous Knowledge:
It is recommended to participate in "Implantate und Frakturheilung" before attending "Experimentelle Methoden".

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students can describe the different ways how bones heal, and the requirements for their existence.
The students can name different treatments for the spine and hollow bones under given fracture morphologies.
The students can describe different measurement techniques for forces and movements, and choose the adequate technique for a given task.
Capabilities:
The students can determine the forces acting within the human body under quasi-static situations under specific assumptions.
The students can describe the basic handling of several experimental techniques used in biomechanics.

Personal Competence:
Social Competence:
The students can, in groups, solve basic experimental tasks.
Autonomy:
The students can, in groups, solve basic experimental tasks.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Biomechanics: Compulsory
General Engineering Science (German program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Biomechanics: Compulsory
Mechanical Engineering: Vertiefung Biomechanics: Compulsory
Technomathematics: Vertiefung Engineering Science: Compulsory suffrage

Course: Experimental Methods in Biomechanics ()

Lecturer:
Prof. Michael Morlock

Language:
DE

Cycle:
SS

Content:

Literature:

Course: Implants and Fracture Healing (Vorlesung)

Lecturer:
Prof. Michael Morlock

Language:
DE

Cycle:
WS

Content:

Topics to be covered include:

1. Introduction (history, definitions, background importance)
2. Bone (anatomy, properties, biology, adaptations in femur, tibia, humerus, radius)
3. Spine (anatomy, biomechanics, function, vertebral bodies, intervertebral disc, ligaments)

3.1 The spine in its entirety
3.2 Cervical spine
3.3 Thoracic spine
3.4 Lumbar spine
3.5 Injuries and diseases

4. Pelvis (anatomy, biomechanics, fracture treatment)

5 Fracture Healing
5.1 Basics and biology of fracture repair
5.2 Clinical principals and terminology of fracture treatment
5.3 Biomechanics of fracture treatment
5.3.1 Screws
5.3.2 Plates
5.3.3 Nails
5.3.4 External fixation devices
5.3.5 Spine implants
6.0 New Implants

Literature:

Cochran V.B.: Orthopädische Biomechanik
Mow V.C., Hayes W.C.: Basic Orthopaedic Biomechanics
White A.A., Panjabi M.M.: Clinical biomechanics of the spine
Nigg, B.: Biomechanics of the musculo-skeletal system
Schiebler T.H., Schmidt W.: Anatomie
Platzer: dtv-Atlas der Anatomie, Band 1 Bewegungsapparat

Module: MED II: Medical Basics II

Courses:

Title	Typ	Hrs/wk
Introduction to Biochemistry and Molecular Biology	Vorlesung	2
Introduction to Physiology	Vorlesung	2

Module Responsibility:
Prof. Michael Morlock

Admission Requirements:

Recommended Previous Knowledge:

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students can

- describe basic biomolecules;
- explain how genetic information is coded in the DNA;
- explain the connection between DNA and proteins;
- describe the basics of the energy metabolism;
- explain pathobiochemical connections for certain common (tumors, diabetes, infections diseases) and some rarer genetic diseases; and
- describe physiological connections in select fields of muscle, heart/circulation, neuro- and sensory physiology.

Capabilities:
The students can

- recognize the importance of molecular parameters for the course of a disease;
- describe different molecular-diagnostic treatments;
- describe the importance of those treatments for some diseases; and
- describe the effects of basic bodily functions (sensory, transmission and processing of information, development of forces and vital functions) and relate them to similar technical systems.

Personal Competence:
Social Competence:
The students can conduct discussions in research and medicine on a technical level.
The students can find solutions to problems in the field of physiology, both analytical and metrological.
Autonomy:
The students can develop understanding of topics from the course, using technical literature, by themselves

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Biomechanics: Compulsory
General Engineering Science (German program): Vertiefung Biomedical Engineering: Compulsory
Electrical Engineering: Vertiefung Medical Technology: Compulsory suffrage
General Engineering Science (English program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Biomechanics: Compulsory
Mechanical Engineering: Vertiefung Biomechanics: Compulsory
Technomathematics: Kernqualifikation: Compulsory suffrage

Course: Introduction to Biochemistry and Molecular Biology (Vorlesung)

Lecturer:
Dr. Hans-Jürgen Kreienkamp

Language:
DE

Cycle:
WS/SS

Content:

Literature:

Müller-Esterl, Biochemie, Spektrum Verlag, 2010; 2. Auflage
Löffler, Basiswissen Biochemie, 7. Auflage, Springer, 2008

Course: Introduction to Physiology (Vorlesung)

Lecturer:

Dr. Roger Zimmermann

Language:

DE

Cycle:

SS

Content:

Literature:

Taschenatlas der Physiologie, Silbernagl Despopoulos, ISBN 978-3-135-67707-1, Thieme
Repetitorium Physiologie, Speckmann, ISBN 978-3-437-42321-5, Elsevier

Courses:

Title	Typ	Hrs/wk
Numerical Mathematics I	Vorlesung	2
Numerical Mathematics I	Gruppenübung	2

Module Responsibility:
Prof. Sabine Le Borne

Admission Requirements:

- Mathematik I + II for Engineering Students (german or english)

or

- Analysis & Linear Algebra I + II for Technomathematicians

Recommended Previous Knowledge:

- Lecture material of prerequisite lectures
- basic MATLAB knowledge

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students are able to

- name numerical methods for interpolation, integration, least squares problems, eigenvalue problems, nonlinear root finding problems and to explain their core ideas,
- repeat convergence statements for the numerical methods,
- explain aspects for the practical execution of numerical methods with respect to computational and storage complexitx.

Capabilities:
Students are able to

- implement, apply and compare numerical methods using MATLAB,
- justify the convergence behaviour of numerical methods with respect to the problem and solution algorithm,
- select and execute a suitable solution approach for a given problem.

Personal Competence:
Social Competence:
Students are able to

- work together in heterogeneously composed teams (i.e., teams from different study programs and background knowledge), explain theoretical foundations and support each other with practical aspects regarding the implementation of algorithms.

Autonomy:
Students are capable

- to assess whether the supporting theoretical and practical excercises are better solved individually or in a team,
- to assess their individual progess and, if necessary, to ask questions and seek help.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Computer Science and Engineering: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Biomechanics: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Materials in Engineering Sciences: Compulsory
General Engineering Science (German program): Vertiefung Biomedical Engineering: Compulsory
Bioprocess Engineering: Vertiefung A - General Bioprocess Engineering: Compulsory suffrage
Computer Science: Vertiefung Computational Mathematics: Compulsory suffrage
Electrical Engineering: Kernqualifikation: Compulsory suffrage
Electrical Engineering myTrack: Kernqualifikation: Compulsory suffrage

General Engineering Science (English program): Vertiefung Computer Science and Engineering: Compulsory
General Engineering Science (English program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Biomechanics: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Materials in Engineering Sciences: Compulsory
Computational Science and Engineering: Kernqualifikation: Compulsory
Process Engineering: Vertiefung Process Engineering : Compulsory suffrage

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Course: Numerical Mathematics I (Vorlesung)

Lecturer:
Prof. Sabine Le Borne

Language:
DE

Cycle:
WS

Content:

1. Error analysis: Number representation, error types, conditioning and stability
2. Interpolation: polynomial and spline interpolation
3. Numerical integration and differentiation: order, Newton-Cotes formula, error estimates, Gaussian quadrature, adaptive quadrature, difference formulas
4. Linear systems: LU and Cholesky factorization, matrix norms, conditioning
5. Linear least squares problems: normal equations, Gram.Schmidt and Householder orthogonalization, singular value decomposition, regularization
6. Eigenvalue problems: power iteration, inverse iteration, QR algorithm
7. Nonlinear systems of equations: Fixed point iteration, root-finding algorithms for real-valued functions, Newton and Quasi-Newton methods for systems

Literature:

- Stoer/Bulirsch: Numerische Mathematik 1, Springer
- Dahmen, Reusken: Numerik für Ingenieure und Naturwissenschaftler, Springer

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Course: Numerical Mathematics I (Übung)

Lecturer:
Prof. Sabine Le Borne

Language:
DE

Cycle:
WS

Content:

1. Error analysis: Number representation, error types, conditioning and stability
2. Interpolation: polynomial and spline interpolation
3. Numerical integration and differentiation: order, Newton-Cotes formula, error estimates, Gaussian quadrature, adaptive quadrature, difference formulas
4. Linear systems: LU and Cholesky factorization, matrix norms, conditioning
5. Linear least squares problems: normal equations, Gram.Schmidt and Householder orthogonalization, singular value decomposition, regularization
6. Eigenvalue problems: power iteration, inverse iteration, QR algorithm
7. Nonlinear systems of equations: Fixed point iteration, root-finding algorithms for real-valued functions, Newton and Quasi-Newton methods for systems

Literature:

- Stoer/Bulirsch: Numerische Mathematik 1, Springer
- Dahmen, Reusken: Numerik für Ingenieure und Naturwissenschaftler, Springer

Module: Heat Transfer

Courses:

Title	Typ	Hrs/wk
Heat Transfer	Vorlesung	3
Heat Transfer	Hörsaalübung	1

Module Responsibility:
Prof. Heinz Herwig

Admission Requirements:
none

Recommended Previous Knowledge:
Technical Thermodynamics I, II and Fluid Dynamics

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students are able to
- describe the different physical mechanism of Heat Transfer,
- explain the technical terms,
- to analyse comlex heat transfer processes in a critical way.

Capabilities:
The students are able to
- understand the physics of Heat Transfer,
- calculate and evaluate complex Heat Transfer processes,
- solve excersises self-consistent and in small groups.

Personal Competence:
Social Competence:
The students are able to discuss in small groups and develop an approach.
Autonomy:
The students are able to develop a complex problem self-consistent and analyse the results in a critical way. A qualified exchange with other students is given.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Biomechanics: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Energy Systems: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Theoretical Mechanical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Biomechanics: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Energy Systems: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Theoretical Mechanical Engineering: Compulsory
Mechanical Engineering: Vertiefung Energy Systems: Compulsory
Mechanical Engineering: Vertiefung Theoretical Mechanical Engineering: Compulsory

Course: Heat Transfer (Vorlesung)

Lecturer:
Prof. Heinz Herwig

Language:
DE

Cycle:
WS

Content:
Dimensional analysis, heat conduction, convective heat transfer, Two- phase heat transfer (evaporation, condensation), thermal radiation, heat exchangers, measurement methods

Literature:

- Herwig, H.; Moschallski, A.: Wärmeübertragung, 2. Auflage, Vieweg+Teubner Verlag, Wiesbaden, 2009
- Herwig, H.: Wärmeübertragung von A-Z, Springer- Verlag, Berlin, Heidelberg, 2000
- Baehr, H.D.; Stephan, K.: Wärme- und Stoffübertragung, 2. Auflage, Springer Verlag, Berlin, Heidelberg, 1996

Course: Heat Transfer (Übung)

Lecturer:
Prof. Heinz Herwig

Language:
DE

Cycle:
WS

Content:
Dimensional analysis, heat conduction, convective heat transfer, Two- phase heat transfer (evaporation, condensation), thermal radiation, heat exchangers, measurement methods

Literature:

- Herwig, H.; Moschallski, A.: Wärmeübertragung, 2. Auflage, Vieweg+Teubner Verlag, Wiesbaden, 2009
- Herwig, H.: Wärmeübertragung von A-Z, Springer- Verlag, Berlin, Heidelberg, 2000
- Baehr, H.D.; Stephan, K.: Wärme- und Stoffübertragung, 2. Auflage, Springer Verlag, Berlin, Heidelberg, 1996

Module: Measurement Technology for Mechanical and Process Engineers

Courses:

Title	Typ	Hrs/wk
Practical Course: Measurement and Control Systems	Laborpraktikum	2
Measurement Technology for Mechanical and Process Engineers	Vorlesung	2
Measurement Technology for Mechanical and Process Engineers	Hörsaalübung	1

Module Responsibility:
NN

Admission Requirements:
none

Recommended Previous Knowledge:
Basic knowledge of physics, chemistry and electrical engineering

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students are able to name the most important fundmentals of the Measurement Technology (Quantities and Units, Uncertainty, Calibration, Static and Dynamic Properties of Sensors and Systems).
They can outline the most important measuring methods for different kinds of quantities to be maesured (Electrical Quantities, Temperature, mechanical quantities, Flow, Time, Frequency).
They can describe important methods of chemical Analysis (Gas Sensors, Spectroscopy, Gas Chromatography)

Capabilities:
Students can select suitable measuring methods to given problems and can use refering measurement devices in practice.

Personal Competence:
Social Competence:
Students can arrive at work results in groups and document them in a common report.

Autonomy:
Students are able to familiarize themselves with new measurement technologies.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 110, Study Time in Lecture: 70

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Biomedical Engineering: Compulsory
Energy and Environmental Engineering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Biomedical Engineering: Compulsory
Mechanical Engineering: Kernqualifikation: Compulsory
Mechatronics: Kernqualifikation: Compulsory

Course: Practical Course: Measurement and Control Systems (Laborpraktikum)

Lecturer:
NN

Language:
DE

Cycle:
WS/SS

Content:
Experiment 1: Emission and immission measurement of gaseous pollutants: different technologies to determine different gaseous pollutants in automotive exhaust are used.
Experiment 2: Simulation and measurement of asynchrone engine and rotary pump: the dynamic behaviour of e pump engine will be investigated. The starting will be simulated on a PC and compared with measurement.
Experiment 3: Michelson interferometer and fiber optic: fundamental optical phenonema will be understood and applications with Michelson

interferometer and optical fibers demonstrated.
Experiment 4:Identification of the parameters of a control system and optimal control parameters

Literature:

Versuch 1:

- Leith, W.: Die Analyse der Luft und ihrer Verunreinigung in der freien Atmosphäre und am Arbeitsplatz. 2. Aufl., Wissenschaftliche Verlagsgesellschaft, Stuttgart, 1974
- Birkle, M.: Meßtechnik für den Immissionsschutz, Messen der gas- und partikelförmigen Luftverunreinigungen. R. Oldenburg Verlag, München-Wien, 1979
- Luftbericht 83/84, Freie und Hansestadt Hamburg, Behörde für Bezirksangelegenheiten, Naturschutz und Umweltgestaltung
- Gebrauchs- und Bedienungsanweisungen
- VDI-Handbuch Reinhaltung der Luft, Band 5: VDI-Richtlinien 2450 Bl.1, 2451 Bl.4, 2453 Bl.5, 2455 Bl.1

Versuch 2:

- Grundlagen über elektrische Maschinen, speziell: Asynchronmotoren
- Simulationsmethoden, speziell: Verwendung von Blockschaltbildern
- Betriebsverhalten von Kreispumpen, speziell: Kennlinien, Ähnlichkeitsgesetze

Versuch 3:

- Unger, H.-G.: Optische Nachrichtentechnik, Teil 1: Optische Wellenleiter. Hüthing Verlag, Heidelberg, 1984
- Dakin, J., Cushaw, B.: Optical Fibre Sensors: Principles and Components. Artech House Boston, 1988
- Culshaw, B., Dakin, J.: Optical Fibre Sensors: Systems and Application. Artech House Boston, 1989

Versuch 4:

- Leonhard: Einführung in die Regelungstechnik. Vieweg Verlag, Braunschweig-Wiesbaden
- Jan Lunze: Systemtheoretische Grundlagen, Analyse und Entwurf einschleifiger Regelungen

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Course: Measurement Technology for Mechanical and Process Engineers (Vorlesung)

Lecturer:
NN

Language:
DE

Cycle:
WS

Content:
1 Fundamentals
1.1 Quantities and Units
1.2 Uncertainty
1.3 Calibration
1.4 Static and Dynamic Properties of Sensors and Systems
2 Measurement of Electrical Quantities
2.1 Current and Voltage
2.2 Impedance
2.3 Amplification
2.4 Oscilloscope
2.5 Analog-to-Digital Conversion
2.6 Data Transmission
3 Measurement of Nonelectric Quantities
3.1 Temperature
3.2 Length, Displacement, Angle
3.3 Strain, Force, Pressure
3.4 Flow
3.5 Time, Frequency
4 Chemical Analysis
4.1 Gas Sensors
4.2 Spectroscopy
4.3 Gas Chromatography

Literature:
Lerch, R.: „Elektrische Messtechnik; Analoge, digitale und computergestützte Verfahren“, Springer, 2006, ISBN: 978-3-540-34055-3.
Profos, P. Pfeifer, T.: „Handbuch der industriellen Messtechnik“, Oldenbourg, 2002, ISBN: 978-3486217940.

Course: Measurement Technology for Mechanical and Process Engineers (Übung)

Lecturer:

NN

Language:

DE

Cycle:

WS

Content:

1 Fundamentals
1.1 Quantities and Units
1.2 Uncertainty
1.3 Calibration
1.4 Static and Dynamic Properties of Sensors and Systems
2 Measurement of Electrical Quantities
2.1 Current and Voltage
2.2 Impedance
2.3 Amplification
2.4 Oscilloscope
2.5 Analog-to-Digital Conversion
2.6 Data Transmission
3 Measurement of Nonelectric Quantities
3.1 Temperature
3.2 Length, Displacement, Angle
3.3 Strain, Force, Pressure
3.4 Flow
3.5 Time, Frequency
4 Chemical Analysis
4.1 Gas Sensors
4.2 Spectroscopy
4.3 Gas Chromatography

Literature:

Lerch, R.: „Elektrische Messtechnik; Analoge, digitale und computergestützte Verfahren“, Springer, 2006, ISBN: 978-3-540-34055-3.
Profos, P. Pfeifer, T.: „Handbuch der industriellen Messtechnik“, Oldenbourg, 2002, ISBN: 978-3486217940.

Courses:

Title	Typ	Hrs/wk
Introduction to Management	Vorlesung	4
Project Entrepreneurship	Problemorientierte Lehrveranstaltung	2

Module Responsibility:
Prof. Kathrin Fischer

Admission Requirements:
None

Recommended Previous Knowledge:
Basic Knowledge of Mathematics and Business

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
After taking this module, students know the important basics of many different areas in Business and Management, from Planning and Organisation to Marketing and Innovation, and also to Investment and Controlling. In particular they are able to

- explain the differences between Economics and Management and the sub-disciplines in Management and to name important definitions from the field of Management
- explain the most important aspects of and goals in Management and name the most important aspects of entreprneurial projects
- describe and explain basic business functions as production, procurement and sourcing, supply chain management, organization and human ressource management, information management, innovation management and marketing
- explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives and uncertainty, and explain some basic methods from mathematical Finance
- state basics from accounting and costing and selected controlling methods.

Capabilities:
Students are able to analyse business units with respect to different criteria (organization, objectives, strategies etc.) and to carry out an Entrepreneurship project in a team. In particular, they are able to

- analyse Management goals and structure them appropriately
- analyse organisational and staff structures of companies
- apply methods for decision making under multiple objectives, under uncertainty and under risk
- analyse production and procurement systems and Business information systems
- analyse and apply basic methods of marketing
- select and apply basic methods from mathematical finance to predefined problems
- apply basic methods from accounting, costing and controlling to predefined problems

Personal Competence:
Social Competence:
Students are able to

- work successfully in a team of students
- to apply their knowledge from the lecture to an entrepreneurship project and write a coherent report on the project
- to communicate appropriately and
- to cooperate respectfully with their fellow students.

Autonomy:
Students are able to

- work in a team and to organize the team themselves
- to write a report on their project.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 96, Study Time in Lecture: 84

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Electrical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Computer Science and Engineering: Compulsory
General Engineering Science (German program): Vertiefung Chemical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Bioprocess Engineering: Compulsory

General Engineering Science (German program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (German program): Vertiefung Civil- and Enviromental Engeneering: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Naval Architecture: Compulsory
Civil- and Environmental Engeneering: Kernqualifikation: Compulsory
Bioprocess Engineering: Kernqualifikation: Compulsory
Computer Science: Kernqualifikation: Compulsory
Electrical Engineering: Kernqualifikation: Compulsory
Electrical Engineering myTrack: Kernqualifikation: Compulsory
Energy and Environmental Engineering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Civil- and Enviromental Engeneering: Compulsory
General Engineering Science (English program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (English program): Vertiefung Electrical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (English program): Vertiefung Computer Science and Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Naval Architecture: Compulsory
General Engineering Science (English program): Vertiefung Chemical Engineering: Compulsory
Computational Science and Engineering: Kernqualifikation: Compulsory
Logistics and Mobility: Kernqualifikation: Compulsory
Mechanical Engineering: Kernqualifikation: Compulsory
Mechatronics: Kernqualifikation: Compulsory
Naval Architecture: Kernqualifikation: Compulsory
Technomathematics: Kernqualifikation: Compulsory
Process Engineering: Kernqualifikation: Compulsory

Course: Introduction to Management (Vorlesung)

Lecturer:
Prof. Kathrin Fischer, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Cornelius Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona

Language:
DE

Cycle:
WS/SS

Content:

- Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management
- Important definitions from Management,
- Developing Objectives for Business, and their relation to important Business functions
- Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supply Chain Management, Innovation Management, Marketing and Sales
  Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management
- Definitions as information, information systems, aspects of data security and strategic information systems
- Definition and Relevance of innovations, e.g. innovation opporunities, risks etc.
- Relevance of marketing, B2B vs. B2C-Marketing
- different techniques from the field of marketing (e.g. scenario technique), pricing strategies
- important organizational structures
- basics of human ressource management
- Introduction to Business Planning and the steps of a planning process
- Decision Analysis: Elements of decision problems and methods for solving decision problems
- Selected Planning Tasks, e.g. Investment and Financial Decisions
- Introduction to Accounting: Accounting, Balance-Sheets, Costing
- Relevance of Controlling and selected Controlling methods
- Important aspects of Entrepreneurship projects

Literature:
Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008
Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003
Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006.
Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001.
Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgart 2008.
Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeine Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005.
Weber, J., Schäffer, U. : Einführung in das Controlling, 12. Auflage, Stuttgart 2008.
Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006.

Course: Project Entrepreneurship (Problemorientierte Lehrveranstaltung)

Lecturer:
Prof. Christoph Ihl

Language:
DE

Cycle:
WS/SS

Content:
In this project module, students work on an Entrepreneurship project. They are required to go through all relevant steps, from the first idea to the concept, using their knowledge from the corresponding lecture.
Project work is carried out in teams with the support of a mentor.

Literature:
Relevante Literatur aus der korrespondierenden Vorlesung.

Module: Fundamentals of Materials Science

Courses:

Title	Typ	Hrs/wk
Fundamentals of Materials Science I	Vorlesung	2
Fundamentals of Materials Science II (Advanced Ceramic Materials, Polymers and Composites)	Vorlesung	2
Physical and Chemical Basics of Materials Science	Vorlesung	2

Module Responsibility:
Prof. Jörg Weißmüller

Admission Requirements:
None

Recommended Previous Knowledge:
Highschool-level physics, chemistry und mathematics

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students have acquired a fundamental knowledge on metals, ceramics and polymers and can describe this knowledge comprehensively. Fundamental knowledge here means specifically the issues of atomic structure, microstructure, phase diagrams, phase transformations, corrosion and mechanical properties. The students know about the key aspects of characterization methods for materials and can identify relevant approaches for characterizing specific properties. They are able to trace materials phenomena back to the underlying physical and chemical laws of nature.

Capabilities:
The students are able to trace materials phenomena back to the underlying physical and chemical laws of nature. Materials phenomena here refers to mechanical properties such as strength, ductility, and stiffness, chemical properties such as corrosion resistance, and to phase transformations such as solidification, precipitation, or melting. The students can explain the relation between processing conditions and the materials microstructure, and they can account for the impact of microstructure on the material's behavior.

Personal Competence:
Social Competence:
-
Autonomy:
-

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 96, Study Time in Lecture: 84

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Naval Architecture: Compulsory
Energy and Environmental Engineering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Naval Architecture: Compulsory
Logistics and Mobility: Vertiefung Engineering Science: Compulsory suffrage
Mechanical Engineering: Kernqualifikation: Compulsory
Mechatronics: Kernqualifikation: Compulsory
Naval Architecture: Kernqualifikation: Compulsory
Technomathematics: Vertiefung Engineering Science: Compulsory suffrage

Course: Fundamentals of Materials Science I (Vorlesung)

Lecturer:
Prof. Jörg Weißmüller

Language:
DE

Cycle:
WS

Content:

Literature:
Vorlesungsskript
W.D. Callister: Materials Science and Engineering - An Introduction. 5th ed., John Wiley & Sons, Inc., New York, 2000, ISBN 0-471-32013-7

Course: Fundamentals of Materials Science II (Advanced Ceramic Materials, Polymers and Composites) (Vorlesung)

Lecturer:
Prof. Bodo Fiedler, Prof. Gerold Schneider

Language:
DE

Cycle:
SS

Content:
Chemische Bindungen und Aufbau von Festkörpern; Kristallaufbau; Werkstoffprüfung; Schweißbarkeit; Herstellung von Keramiken; Aufbau und Eigenschaften der Keramik; Herstellung, Aufbau und Eigenschaften von Gläsern; Polymerwerkstoffe, Makromolekularer Aufbau; Struktur und Eigenschaften der Polymere; Polymerverarbeitung; Verbundwerkstoffe

Literature:
Vorlesungsskript
W.D. Callister: Materials Science and Engineering -An Introduction-5th ed., John Wiley & Sons, Inc., New York, 2000, ISBN 0-471-32013-7

Course: Physical and Chemical Basics of Materials Science (Vorlesung)

Lecturer:
Prof. Stefan Müller

Language:
DE

Cycle:
WS

Content:

Literature:
Für den **Elektromagnetismus:**

- Bergmann-Schäfer: „Lehrbuch der Experimentalphysik“, Band 2: „Elektromagnetismus“, de Gruyter

Für die **Atomphysik:**

- Haken, Wolf: „Atom- und Quantenphysik“, Springer

Für die **Materialphysik und Elastizität:**

- Hornbogen, Warlimont: „Metallkunde“, Springer

Courses:

Title	Typ	Hrs/wk
Introduction to Management	Vorlesung	4
Project Entrepreneurship	Problemorientierte Lehrveranstaltung	2

Module Responsibility:
Prof. Kathrin Fischer

Admission Requirements:
None

Recommended Previous Knowledge:
Basic Knowledge of Mathematics and Business

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
After taking this module, students know the important basics of many different areas in Business and Management, from Planning and Organisation to Marketing and Innovation, and also to Investment and Controlling. In particular they are able to

- explain the differences between Economics and Management and the sub-disciplines in Management and to name important definitions from the field of Management
- explain the most important aspects of and goals in Management and name the most important aspects of entreprneurial projects
- describe and explain basic business functions as production, procurement and sourcing, supply chain management, organization and human ressource management, information management, innovation management and marketing
- explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives and uncertainty, and explain some basic methods from mathematical Finance
- state basics from accounting and costing and selected controlling methods.

Capabilities:
Students are able to analyse business units with respect to different criteria (organization, objectives, strategies etc.) and to carry out an Entrepreneurship project in a team. In particular, they are able to

- analyse Management goals and structure them appropriately
- analyse organisational and staff structures of companies
- apply methods for decision making under multiple objectives, under uncertainty and under risk
- analyse production and procurement systems and Business information systems
- analyse and apply basic methods of marketing
- select and apply basic methods from mathematical finance to predefined problems
- apply basic methods from accounting, costing and controlling to predefined problems

Personal Competence:
Social Competence:
Students are able to

- work successfully in a team of students
- to apply their knowledge from the lecture to an entrepreneurship project and write a coherent report on the project
- to communicate appropriately and
- to cooperate respectfully with their fellow students.

Autonomy:
Students are able to

- work in a team and to organize the team themselves
- to write a report on their project.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 96, Study Time in Lecture: 84

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Electrical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Computer Science and Engineering: Compulsory
General Engineering Science (German program): Vertiefung Chemical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Bioprocess Engineering: Compulsory

General Engineering Science (German program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (German program): Vertiefung Civil- and Enviromental Engeneering: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Naval Architecture: Compulsory
Civil- and Environmental Engeneering: Kernqualifikation: Compulsory
Bioprocess Engineering: Kernqualifikation: Compulsory
Computer Science: Kernqualifikation: Compulsory
Electrical Engineering: Kernqualifikation: Compulsory
Electrical Engineering myTrack: Kernqualifikation: Compulsory
Energy and Environmental Engineering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Civil- and Enviromental Engeneering: Compulsory
General Engineering Science (English program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (English program): Vertiefung Electrical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (English program): Vertiefung Computer Science and Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Naval Architecture: Compulsory
General Engineering Science (English program): Vertiefung Chemical Engineering: Compulsory
Computational Science and Engineering: Kernqualifikation: Compulsory
Logistics and Mobility: Kernqualifikation: Compulsory
Mechanical Engineering: Kernqualifikation: Compulsory
Mechatronics: Kernqualifikation: Compulsory
Naval Architecture: Kernqualifikation: Compulsory
Technomathematics: Kernqualifikation: Compulsory
Process Engineering: Kernqualifikation: Compulsory

Course: Introduction to Management (Vorlesung)

Lecturer:
Prof. Kathrin Fischer, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Cornelius Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona

Language:
DE

Cycle:
WS/SS

Content:

- Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management
- Important definitions from Management,
- Developing Objectives for Business, and their relation to important Business functions
- Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supply Chain Management, Innovation Management, Marketing and Sales
  Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management
- Definitions as information, information systems, aspects of data security and strategic information systems
- Definition and Relevance of innovations, e.g. innovation opporunities, risks etc.
- Relevance of marketing, B2B vs. B2C-Marketing
- different techniques from the field of marketing (e.g. scenario technique), pricing strategies
- important organizational structures
- basics of human ressource management
- Introduction to Business Planning and the steps of a planning process
- Decision Analysis: Elements of decision problems and methods for solving decision problems
- Selected Planning Tasks, e.g. Investment and Financial Decisions
- Introduction to Accounting: Accounting, Balance-Sheets, Costing
- Relevance of Controlling and selected Controlling methods
- Important aspects of Entrepreneurship projects

Literature:
Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008
Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003
Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006.
Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001.
Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgart 2008.
Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeine Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005.
Weber, J., Schäffer, U. : Einführung in das Controlling, 12. Auflage, Stuttgart 2008.
Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006.

Course: Project Entrepreneurship (Problemorientierte Lehrveranstaltung)

Lecturer:
Prof. Christoph Ihl

Language:
DE

Cycle:
WS/SS

Content:
In this project module, students work on an Entrepreneurship project. They are required to go through all relevant steps, from the first idea to the concept, using their knowledge from the corresponding lecture.
Project work is carried out in teams with the support of a mentor.

Literature:
Relevante Literatur aus der korrespondierenden Vorlesung.

Courses:

Title	Typ	Hrs/wk
Differential Equations 2 (Partial Differential Equations)	Vorlesung	2
Differential Equations 2 (Partial Differential Equations)	Gruppenübung	1
Differential Equations 2 (Partial Differential Equations)	Hörsaalübung	1
Complex Functions	Vorlesung	2
Complex Functions	Gruppenübung	1
Complex Functions	Hörsaalübung	1

Module Responsibility:
Prof. Anusch Taraz

Admission Requirements:
none

Recommended Previous Knowledge:
Mathematics 1 - III

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:

- Students can name the basic concepts in Mathematics IV. They are able to explain them using appropriate examples.
- Students can discuss logical connections between these concepts. They are capable of illustrating these connections with the help of examples.
- They know proof strategies and can reproduce them.

Capabilities:

- Students can model problems in Mathematics IV with the help of the concepts studied in this course. Moreover, they are capable of solving them by applying established methods.
- Students are able to discover and verify further logical connections between the concepts studied in the course.
- For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results.

Personal Competence:
Social Competence:

- Students are able to work together in teams. They are capable to use mathematics as a common language.
- In doing so, they can communicate new concepts according to the needs of their cooperating partners. Moreover, they can design examples to check and deepen the understanding of their peers.

Autonomy:

- Students are capable of checking their understanding of complex concepts on their own. They can specify open questions precisely and know where to get help in solving them.
- Students have developed sufficient persistence to be able to work for longer periods in a goal-oriented manner on hard problems.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 68, Study Time in Lecture: 112

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Electrical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Mechatronics: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Theoretical Mechanical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Naval Architecture: Compulsory
Computer Science: Vertiefung Computational Mathematics: Compulsory suffrage
Electrical Engineering: Kernqualifikation: Compulsory

Electrical Engineering myTrack: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Electrical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Naval Architecture: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Mechatronics: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Theoretical Mechanical Engineering: Compulsory
Computational Science and Engineering: Vertiefung Engineering Sciences: Compulsory suffrage
Mechanical Engineering: Vertiefung Theoretical Mechanical Engineering: Compulsory
Mechanical Engineering: Vertiefung Mechatronics: Compulsory
Mechatronics: Kernqualifikation: Compulsory
Naval Architecture: Kernqualifikation: Compulsory

Course: Differential Equations 2 (Partial Differential Equations) (Vorlesung)

Lecturer:
Dozenten des Fachbereiches Mathematik der UHH

Language:
DE

Cycle:
SS

Content:
Main features of the theory and numerical treatment of partial differential equations

- Examples of partial differential equations
- First order quasilinear differential equations
- Normal forms of second order differential equations
- Harmonic functions and maximum principle
- Maximum principle for the heat equation
- Wave equation
- Liouville's formula
- Special functions
- Difference methods
- Finite elements

Literature:

- R. Ansorge, H. J. Oberle: Mathematik für Ingenieure, Band 2; Verlag Wiley-VCH, Berlin, Weinheim, New York, 2000
- P. Henrici, R. Jelsch: Komplexe Analysis für Ingenieure, Birkhäuser Verlag, Basel, 1998
- A. Tveito, R. Winther: Einführung in partielle Differentialgleichungen, Springer Verlag, Berlin, Heidelberg, New York, 2002

Course: Differential Equations 2 (Partial Differential Equations) (Übung)

Lecturer:
Dozenten des Fachbereiches Mathematik der UHH

Language:
DE

Cycle:
SS

Content:
Main features of the theory and numerical treatment of partial differential equations

- Examples of partial differential equations
- First order quasilinear differential equations
- Normal forms of second order differential equations
- Harmonic functions and maximum principle
- Maximum principle for the heat equation
- Wave equation
- Liouville's formula
- Special functions
- Difference methods
- Finite elements

Literature:

- R. Ansorge, H. J. Oberle: Mathematik für Ingenieure, Band 2; Verlag Wiley-VCH, Berlin, Weinheim, New York, 2000
- P. Henrici, R. Jelsch: Komplexe Analysis für Ingenieure, Birkhäuser Verlag, Basel, 1998
- A. Tveito, R. Winther: Einführung in partielle Differentialgleichungen, Springer Verlag, Berlin, Heidelberg, New York, 2002

Course: Differential Equations 2 (Partial Differential Equations) (Ubung)

Lecturer:
Dozenten des Fachbereiches Mathematik der UHH

Language:
DE

Cycle:
SS

Content:
Main features of the theory and numerical treatment of partial differential equations

- Examples of partial differential equations
- First order quasilinear differential equations
- Normal forms of second order differential equations
- Harmonic functions and maximum principle
- Maximum principle for the heat equation
- Wave equation
- Liouville's formula
- Special functions
- Difference methods
- Finite elements

Literature:

- R. Ansorge, H. J. Oberle: Mathematik für Ingenieure, Band 2; Verlag Wiley-VCH, Berlin, Weinheim, New York, 2000
- P. Henrici, R. Jelsch: Komplexe Analysis für Ingenieure, Birkhäuser Verlag, Basel, 1998
- A. Tveito, R. Winther: Einführung in partielle Differentialgleichungen, Springer Verlag, Berlin, Heidelberg, New York, 2002

Course: Complex Functions (Vorlesung)

Lecturer:
Dozenten des Fachbereiches Mathematik der UHH

Language:
DE

Cycle:
SS

Content:
Main features of complex analysis

- Functions of one complex variable
- Complex differentiation
- Conformal mappings
- Complex integration
- Cauchy's integral theorem
- Cauchy's integral formula
- Taylor and Laurent series expansion
- Singularities and residuals
- Integral transformations: Fourier and Laplace transformation

Literature:

- R. Ansorge, H. J. Oberle: Mathematik für Ingenieure, Band 2; Verlag Wiley-VCH, Berlin, Weinheim, New York, 2000
- P. Henrici, R. Jelsch: Komplexe Analysis für Ingenieure, Birkhäuser Verlag, Basel, 1998

Course: Complex Functions (Übung)

Lecturer:
Dozenten des Fachbereiches Mathematik der UHH

Language:
DE

Cycle:
SS

Content:
Main features of complex analysis

- Functions of one complex variable
- Complex differentiation
- Conformal mappings

- Complex integration
- Cauchy's integral theorem
- Cauchy's integral formula
- Taylor and Laurent series expansion
- Singularities and residuals
- Integral transformations: Fourier and Laplace transformation

Literature:

- R. Ansorge, H. J. Oberle: Mathematik für Ingenieure, Band 2; Verlag Wiley-VCH, Berlin, Weinheim, New York, 2000
- P. Henrici, R. Jelsch: Komplexe Analysis für Ingenieure, Birkhäuser Verlag, Basel, 1998

Course: Complex Functions (Übung)

Lecturer:
Dozenten des Fachbereiches Mathematik der UHH

Language:
DE

Cycle:
SS

Content:
Main features of complex analysis

- Functions of one complex variable
- Complex differentiation
- Conformal mappings
- Complex integration
- Cauchy's integral theorem
- Cauchy's integral formula
- Taylor and Laurent series expansion
- Singularities and residuals
- Integral transformations: Fourier and Laplace transformation

Literature:

- R. Ansorge, H. J. Oberle: Mathematik für Ingenieure, Band 2; Verlag Wiley-VCH, Berlin, Weinheim, New York, 2000
- P. Henrici, R. Jelsch: Komplexe Analysis für Ingenieure, Birkhäuser Verlag, Basel, 1998

Module: Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems)

Courses:

Title	Typ	Hrs/wk
Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems)	Vorlesung	3
Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems)	Gruppenübung	2
Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems)	Hörsaalübung	1

Module Responsibility:
NN

Admission Requirements:
none

Recommended Previous Knowledge:
Mechanics I (Statics) and Mechanics III (Hydrostatics, Kinematics, Dynamics)
Mathematics I and II

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students can

- describe the axiomatic procedure used in mechanical contexts;
- explain important steps in model design;
- present technical knowledge.

Capabilities:
The students can

- explain the important elements of mathematical / mechanical analysis and model formation, and apply it to the context of their own problems;
- apply basic methods to engineering problems;
- estimate the reach and boundaries of the methods and extend them to be applicable to wider problem sets.

Personal Competence:
Social Competence:
The students can work in groups and support each other to overcome difficulties.
Autonomy:
Students are capable of determining their own strengths and weaknesses and to organize their time and learning based on those.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 96, Study Time in Lecture: 84

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Naval Architecture: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Naval Architecture: Compulsory
Mechanical Engineering: Kernqualifikation: Compulsory
Mechatronics: Kernqualifikation: Compulsory
Naval Architecture: Kernqualifikation: Compulsory
Technomathematics: Kernqualifikation: Compulsory suffrage

Course: Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems) (Vorlesung)

Lecturer:
NN

Language:
DE

Cycle:

SS

Content:

- Simple impact problems
- Principles of analytical mechanics
- Elements of vibration theory
- Basics of continuum vibrations
- Introduction into Modeling of Multibody Systems

Literature:

K. Magnus, H.H. Müller-Slany: Grundlagen der Technischen Mechanik. 7. Auflage, Teubner (2009).
D. Gross, W. Hauger, J. Schröder, W. Wall: Technische Mechanik 1-4. 11. Auflage, Springer (2011).

Course: Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems) (Übung)

Lecturer:

NN

Language:

DE

Cycle:

SS

Content:

- Simple impact problems
- Principles of analytical mechanics
- Elements of vibration theory
- Basics of continuum vibrations
- Introduction into Modeling of Multibody Systems

Literature:

K. Magnus, H.H. Müller-Slany: Grundlagen der Technischen Mechanik. 7. Auflage, Teubner (2009).
D. Gross, W. Hauger, J. Schröder, W. Wall: Technische Mechanik 1-4. 11. Auflage, Springer (2011).

Course: Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems) (Übung)

Lecturer:

NN

Language:

DE

Cycle:

SS

Content:

- Simple impact problems
- Principles of analytical mechanics
- Elements of vibration theory
- Basics of continuum vibrations
- Introduction into Modeling of Multibody Systems

Literature:

K. Magnus, H.H. Müller-Slany: Grundlagen der Technischen Mechanik. 7. Auflage, Teubner (2009).
D. Gross, W. Hauger, J. Schröder, W. Wall: Technische Mechanik 1-4. 11. Auflage, Springer (2011).

Module: Fluid Mechanics for Naval Architects

Courses:

Title	Typ	Hrs/wk
Fluid Mechanics for Naval Architects	Vorlesung	3
Fluid Mechanics for Naval Architects	Hörsaalübung	2

Module Responsibility:
Prof. Thomas Rung

Admission Requirements:

Recommended Previous Knowledge:
Sound knowledge of engineering mathematics and mechanics.

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students will have the required sound knowledge to explain the general principles of fluid engineering and ship hydrodynamics. Students can scientifically outline the rationale of flow physics using mathematical models.
Capabilities:
Students are able to apply fluid-engineering principles and flow-physics models for the analysis of technical systems. The lecture enables the student to carry out fluid-engineering calculations on a scientific level.

Personal Competence:
Social Competence:
Autonomy:

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 110, Study Time in Lecture: 70

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Naval Architecture: Compulsory
General Engineering Science (English program): Vertiefung Naval Architecture: Compulsory
Naval Architecture: Kernqualifikation: Compulsory

Course: Fluid Mechanics for Naval Architects (Vorlesung)

Lecturer:
Prof. Thomas Rung

Language:
DE

Cycle:
SS

Content:
Fundamentals of fluid dynamics, particularly

1. Physical properties & definition of fluids
2. Dimensional analysis & similitude
3. Forces in fluids & fluid statics
4. Transport theorem (conservation of mass, momentum & energy)
5. Elementary dynamics along a streamline
6. Fluid kinematics
7. Potential flows & vortex flows
8. Analytical solutions of the Navier-Stokes equation
9. Turbulent flows & boundary-layer flows
10. Viscous flows in ducts and pipes
11. Flow over immersed bodies

Literature:
J.H. Spurk, N. Aksel: Strömungslehre, Springer Verlag
H. Schade, E. Kunz: Strömungslehre, Walter de Gruyter
B. R. Munson, D.F. Young, T. H. Okiishi: Fundamental of Fluid Mechanics, John Wiley, 2006 (in Englis(c)h)

Course: Fluid Mechanics for Naval Architects (Ubung)

Lecturer:
Prof. Thomas Rung

Language:
DE

Cycle:
SS

Content:
Fundamentals of fluid dynamics, particularly

1. Physical properties & definition of fluids
2. Dimensional analysis & similitude
3. Forces in fluids & fluid statics
4. Transport theorem (conservation of mass, momentum & energy)
5. Elementary dynamics along a streamline
6. Fluid kinematics
7. Potential flows & vortex flows
8. Analytical solutions of the Navier-Stokes equation
9. Turbulent flows & boundary-layer flows
10. Viscous flows in ducts and pipes
11. Flow over immersed bodies

Literature:
J.H. Spurk, N. Aksel: Strömungslehre, Springer Verlag
H. Schade, E. Kunz: Strömungslehre, Walter de Gruyter
B. R. Munson, D.F. Young, T. H. Okiishi: Fundamental of Fluid Mechanics, John Wiley, 2006 (in Englis(c)h)

Module: Stochastics and Ship Dynamics

Courses:

Title	Typ	Hrs/wk
Ship Dynamics	Vorlesung	2
Ship Dynamics	Gruppenübung	1
Statistics and Stochastic Processes in Naval Architecure and Ocean Engineering	Vorlesung	2

Module Responsibility:
Prof. Moustafa Abdel-Maksoud

Admission Requirements:

Recommended Previous Knowledge:
- Technical mechanics
- Linear algebra, analysis, complex numbers
- Fluid mechanics

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
- The students are able to give an overview over various manoeuvres. They can name application goals and they can describe the procedure of the manoeuvres.
- The students are able to give an overview over varius rudder types. They can name criteria in the rudder design.
- The students can name computation methods which are used to determine forces and motions in waves.

Capabilities:
- The students can come up with the equations of motions which are used to discribe manoeuvres. The can use and linearise them.
- The students are able to determine hydrodynamic coefficients and they can explain their physical meaning.
- The students can explain how a rudder works and they can explain the physical effects which can occur.
- The students can mathematically describe waves.
- The students can explain the mathematically description of harmoncial motions in waves and they can determine them.

Personal Competence:
Social Competence:
- The students can arrive at work results in groups and document them.
- The students can discuss in groups and explain their point of view.

Autonomy:
- The students can assess their own strengthes and weaknesses and the define further work steps on this basis.

ECTS-Credit points:
7 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 140, Study Time in Lecture: 70

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Naval Architecture: Compulsory
General Engineering Science (English program): Vertiefung Naval Architecture: Compulsory
Naval Architecture: Kernqualifikation: Compulsory

Course: Ship Dynamics (Vorlesung)

Lecturer:
Prof. Moustafa Abdel-Maksoud

Language:
DE

Cycle:
SS

Content:
Maneuverability of ships

- Equations of motion
- Hydrodynamic forces and moments
- Linear equations and their solutions
- Full-scale trials for evaluating the maneuvering performance

- Regulations for maneuverability
- Rudder

Seakeeping

- Representation of harmonic processes
- Motions of a rigid ship in regular waves
- Flow forces on ship cross sections
- Strip method
- Consequences induced by ship motion in regular waves
- Behavior of ships in a stationary sea state
- Long-term distribution of seaway influences

Literature:

- Abdel-Maksoud, M., Schiffsdynamik, Vorlesungsskript, Institut für Fluiddynamik und Schiffstheorie, Technische Universität Hamburg-Harburg, 2014
- Abdel-Maksoud, M., Ship Dynamics, Lecture notes, Institute for Fluid Dynamic and Ship Theory, Hamburg University of Technology, 2014
- Bertram, V., Practical Ship Design Hydrodynamics, Butterworth-Heinemann, Linacre House - Jordan Hill, Oxford, United Kingdom, 2000
- Bhattacharyya, R., Dynamics of Marine Vehicles, John Wiley & Sons, Canada,1978
- Brix, J. (ed.), Manoeuvring Technical Manual, Seehafen-Verlag, Hamburg, 1993
- Claus, G., Lehmann, E., Östergaard, C). Offshore Structures, I+II, Springer-Verlag. Berlin Heidelberg, Deutschland, 1992
- Faltinsen, O. M., Sea Loads on Ships and Offshore Structures, Cambridge University Press, United Kingdom, 1990
- Handbuch der Werften, Deutschland, 1986
- Jensen, J. J., Load and Global Response of Ships, Elsevier Science, Oxford, United Kingdom, 2001
- Lewis, Edward V. (ed.), Principles of Naval Architecture - Motion in Waves and Controllability, Society of Naval Architects and Marine Engineers, Jersey City, NJ, 1989
- Lewandowski, E. M., The Dynamics of Marine Craft: Maneuvering and Seakeeping, World Scientific, USA, 2004
- Lloyd, A., Ship Behaviour in Rough Weather, Gosport, Chichester, Sussex, United Kingdom, 1998

Course: Ship Dynamics (Übung)

Lecturer:
Prof. Moustafa Abdel-Maksoud

Language:
DE

Cycle:
SS

Content:

Literature:

Course: Statistics and Stochastic Processes in Naval Architecure and Ocean Engineering (Vorlesung)

Lecturer:
Dr. Volker Müller

Language:
DE

Cycle:
WS

Content:

Literature:

Module: Computational Fluid Dynamics I

Courses:

Title	Typ	Hrs/wk
Computational Fluid Dynamics I	Vorlesung	2
Computational Fluid Dynamics I	Hörsaalübung	2

Module Responsibility:
Prof. Thomas Rung

Admission Requirements:
Mathematical Methods for Engineers

Recommended Previous Knowledge:
Fundamentals of Differential/integral calculus and series expansions.

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students are able to list the basic numerics of partial differential equations.

Capabilities:
The students are able develop appropriate numerical integration in space and time for the governing partial differential equations. They can code computational algorithms in a structured way.

Personal Competence:
Social Competence:
The students can arrive at work results in groups and document them.

Autonomy:
The students can independently analyse approaches to solving specific problems.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Mechanical Engineering, Schwerpunkt Energy Systems: Compulsory
General Engineering Science (German program): Vertiefung Naval Architecture: Compulsory
General Engineering Science (English program): Vertiefung Naval Architecture: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering, Schwerpunkt Energy Systems: Compulsory
Computational Science and Engineering: Vertiefung Engineering Sciences: Compulsory suffrage
Naval Architecture: Kernqualifikation: Compulsory
Technomathematics: Vertiefung Engineering Science: Compulsory suffrage

Course: Computational Fluid Dynamics I (Vorlesung)

Lecturer:
Prof. Thomas Rung

Language:
DE

Cycle:
WS

Content:
Fundamentals of computational modelling of thermofluid dynamic problems. Development of numerical algorithms.

1. Partial differential equations
2. Foundations of finite numerical approximations
3. Computation of potential flows
4. Introduction of finite-differences
5. Approximation of convective, diffusive and transient transport processes
6. Formulation of boundary conditions and initial conditions

7. Assembly and solution of algebraic equation systems
8. Facets of weighted -residual approaches
9. Finite volume methods
10. Basics of grid generation

Literature:
Ferziger and Peric: *Computational Methods for Fluid Dynamics*, Springer

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Course: Computational Fluid Dynamics I (Übung)

Lecturer:
Prof. Thomas Rung

Language:
DE

Cycle:
WS

Content:
Fundamentals of computational modelling of thermofluid dynamic problems. Development of numerical algorithms.

1. Partial differential equations
2. Foundations of finite numerical approximations
3. Computation of potential flows
4. Introduction of finite-differences
5. Approximation of convective, diffusive and transient transport processes
6. Formulation of boundary conditions and initial conditions
7. Assembly and solution of algebraic equation systems
8. Facets of weighted -residual approaches
9. Finite volume methods
10. Basics of grid generation

Literature:
Ferziger and Peric: *Computational Methods for Fluid Dynamics*, Springer

Module: Fundamentals of Ship Structural Design and Analysis

Courses:

Title	Typ	Hrs/wk
Fundamentals of Ship Structural Design	Vorlesung	2
Fundamentals of Ship Structural Design	Gruppenübung	1
Fundamentals of Ship Structural Analysis	Vorlesung	2
Fundamentals of Ship Structural Analysis	Gruppenübung	1

Module Responsibility:
Prof. Sören Ehlers

Admission Requirements:
None

Recommended Previous Knowledge:
Mechanics I - III
Fundamentals of Materials Science I - III
Welding Technology I
Fundamentals of Mechanical Design I - III

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students can reproduce the basic contents of the structural behaviour of ship structures; they can explain the theory and methods for the calculation of deformations and stresses in beam-like structures.
Furthermore, they can reproduce the basis contents of codes (rules), materials, semi-finished products, joining and principles of structural design of components in the ship structure.

Capabilities:
Students are capable of applying the methods and tools for the calculation of linear deformations and stresses in the above mentioned structures; they can choose calculation models of typical ship structures.
Furthermore, they are capable to apply the methods of drawing and sizing the ship structure; they can select suitable materials, semi-finished products and joints.

Personal Competence:
Social Competence:
Autonomy:
The students are capable to independently idealize real ship structures and to select suitable methods for analysis of beam-like structures; they are capable to assess the results of structural analyses.
Furthermore, they are capable to assess drawings of complex ship structures and to design ship structures for various requirements and boundary conditions.

ECTS-Credit points:
8 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 156, Study Time in Lecture: 84

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Naval Architecture: Compulsory
General Engineering Science (English program): Vertiefung Naval Architecture: Compulsory
Naval Architecture: Kernqualifikation: Compulsory

Course: Fundamentals of Ship Structural Design (Vorlesung)

Lecturer:
Prof. Sören Ehlers

Language:
DE

Cycle:
WS

Content:

Chapters:
1. Introduction
3. Class societies and their tasks
4. Materials for steel shipbuilding
5. Welding and Cutting
6. Semi-finished products in steel shipbuilding
7. Determining the scantlings for local loads
8. Longitudinal strength of the hull girder
9. Determining the scantlings of longitudinal structural members
10. Determining the scantlings of bottom and side structures
11. Decks and Hatch Openings
12. Effective breadth
13. Iterative determination of scantlings (POSEIDON)

Literature:
Vorlesungsskript mit weiteren Literaturangaben wird über das Internet verfügbar gemacht

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Course: Fundamentals of Ship Structural Design (Übung)

Lecturer:
Prof. Sören Ehlers

Language:
DE

Cycle:
WS

Content:
Chapters:
1. Introduction
3. Class societies and their tasks
4. Materials for steel shipbuilding
5. Welding and Cutting
6. Semi-finished products in steel shipbuilding
7. Determining the scantlings for local loads
8. Longitudinal strength of the hull girder
9. Determining the scantlings of longitudinal structural members
10. Determining the scantlings of bottom and side structures
11. Decks and Hatch Openings
12. Effective breadth
13. Iterative determination of scantlings (POSEIDON)

Literature:
Vorlesungsskript mit weiteren Literaturangaben wird über das Internet verfügbar gemacht

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Course: Fundamentals of Ship Structural Analysis (Vorlesung)

Lecturer:
Prof. Sören Ehlers, Prof. Alexander Düster

Language:
DE

Cycle:
WS

Content:
Contents:
1. Introduction
2. Finite element method (f.e. method) by the example of trussworks
3. Force methods for frameworks
4. F.e. method for frameworks
5. Shear and torsion in thin-walled beams
6. Beams subjected to longitudinal forces

Literature:
Vorlesungsskript mit weiteren Literaturangaben; div. Bücher über die Methode der finiten Elemente

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Course: Fundamentals of Ship Structural Analysis (Übung)

Lecturer:
Prof. Sören Ehlers, Prof. Alexander Düster

Language:
DE

Cycle:

WS

Content:

Contents:
1. Introduction
2. Finite element method (f.e. method) by the example of trussworks
3. Force methods for frameworks
4. F.e. method for frameworks
5. Shear and torsion in thin-walled beams
6. Beams subjected to longitudinal forces

Literature:

Vorlesungsskript mit weiteren Literaturangaben; div. Bücher über die Methode der finiten Elemente

Courses:

Title	Typ	Hrs/wk
Ship Structural Design	Vorlesung	2
Ship Structural Design	Gruppenübung	2
Welding Technology	Vorlesung	3

Module Responsibility:
Prof. Sören Ehlers

Admission Requirements:
None

Recommended Previous Knowledge:
Mechanics I - III
Fundamentals of Materials Science I - III
Welding Technology I
Fundamentals of Mechanical Design I - III

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students can reproduce design and sizing as well as fabrication of the different areas of ship structures and of different ship types (incl. detail design); they can describe calculation models for complex structures.

Capabilities:
Students are capable to specify the requirements for different ship types and areas of the hull, to define design criteria for the components, to select suitable calculation models and to assess the chosen structure

Personal Competence:
Social Competence:
Students are capable to organize the structural design, to develop joint solutions and to document it in groups.

Autonomy:
Students are capable to design independently different structural areas of the ship hull and different ship types and to define appropriate fabrication methods.

ECTS-Credit points:
9 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 172, Study Time in Lecture: 98

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Naval Architecture: Compulsory
General Engineering Science (English program): Vertiefung Naval Architecture: Compulsory
Naval Architecture: Kernqualifikation: Compulsory

Course: Ship Structural Design (Vorlesung)

Lecturer:
Prof. Sören Ehlers

Language:
DE

Cycle:
SS

Content:
Chapters:
1. Bulkheads and tanks
2. Structural design of forebodies
3. Structures in engine rooms

4. Aft bodies and rudders
5. Detail structural design
6. Outfitting
7. Bulk carriers
8. Tankers
9. Container ships
10. Production-kind steel structural design
11. Buckling and ultimate strength
12. Safety factors and reliability of structures

Literature:
Vorlesungsskript mit weiteren Literaturangaben wird über das Internet verfügbar gemacht

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Course: Ship Structural Design (Übung)

Lecturer:
Prof. Sören Ehlers

Language:
DE

Cycle:
SS

Content:
Chapters:
1. Bulkheads and tanks
2. Structural design of forebodies
3. Structures in engine rooms
4. Aft bodies and rudders
5. Detail structural design
6. Outfitting
7. Bulk carriers
8. Tankers
9. Container ships
10. Production-kind steel structural design
11. Buckling and ultimate strength
12. Safety factors and reliability of structures

Literature:
Vorlesungsskript mit weiteren Literaturangaben wird über das Internet verfügbar gemacht

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Course: Welding Technology (Vorlesung)

Lecturer:
Prof. Claus Emmelmann, Prof. Karl-Ulrich Kainer

Language:
DE

Cycle:
WS

Content:
- phase transitions, phase diagrams and thermal activated processes
- fundamentals of steels, heat treatment applications for steels and time temperature transformation diagrams
- properties of weldable carbon and fine grained steels
- properties of weldable low- and high-alloy steels, corrosion resistant steels and high-strength steels
- structure and properties of non-ferrite metals (aluminum, titanium)
- NDT/DT Methods for materials and welds
- gas fusion welding, fundamentals of electric arc welding technologies
- structure and influence parameters for the welded joint
- submerged arc welding/tungsten inert gas welding/inert gas metal arc welding (MIG)/active gas metal arc welding (MAG)/Plasma Welding
- resistance welding/ polymer welding/ hybrid-welding
- deposition welding
- electron beam welding/ laser beam welding
- weld joint designs and declarations
- computation methods for weld joint dimensioning

Literature:
Schulze, G.: Die Metallurgie des Schweißens, 4. Aufl., Berlin 2010 Strassburg, F.W. und Wehner H.: Schweißen nichtrostender Stähle, 4. Aufl. Düsseldorf, 2009 Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 1: Schweiß- und Schneidtechnologien, 3. Aufl., Berlin 2006.
Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 2: Verhalten der Werkstoffe beim Schweißen, 3. Aufl., Berlin 2005.
Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 3: Gestaltung und Festigkeit von Schweißkonstruktionen, 2. Aufl., Berlin 2002.

Module: Resistance and Propulsion

Courses:

Title	Typ	Hrs/wk
Resistance and Propulsion	Vorlesung	2
Resistance and Propulsion	Hörsaalübung	2

Module Responsibility:
Prof. Stefan Krüger

Admission Requirements:
Mechanics, Fluid Dynamics for Naval Archchitecs

Recommended Previous Knowledge:
Hydrostratics, Mechanics, Fluid Dyanamics

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The hydrodynamic basics that are relevant for resistance and propulsion of ships are discussed. The different resistance phenomena and their practical applications to hullform design as well as numerical and empirical prediction methods are subject of the course. Furthermore, environmental additional resistances are dealt with. The course includes model test techniques and their application to full scale ships. This hold also for propulsion and hullefficiency elements, mainly thrust deduction and wake. Main Focus is how hull forms can be optimized for minimum and sustainable fuel consumption. The following topics are dealt with:
- Stillwater/added resistance, Wave resistance, Minimization of wave resistance, numerical prediction methods, friction laws, laminar/turbulent flow separation, Hull form design for redcude flow separation, Appendage Design and resistance, Froude´s resistance law,form factor method, thrust deduction, wake, model scaling laws, resistance tests, free running propeller tests and propeller basics, propulsion tests, full scale speed power predictions, additional resistances (wind, steering, current, sea state), EEDI, speed trials, contractual matters concerning speed/power, bunker claims

Capabilities:
The student shall learn to design competitve hull forms with respect to fuel consumption by applying numreical techniques and to evaluate these hulls by several progosis methods. Furtermore, the course will enable the student to clearl determine and minimize the required power including environmental influences.

Personal Competence:
Social Competence:
The student learns to prepare technical matters in such a way that he can compte with his building suvervision team.
Autonomy:
The student learns to prepare technical matters in such a way that he can compte with his building suvervision team.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Naval Architecture: Compulsory
General Engineering Science (English program): Vertiefung Naval Architecture: Compulsory
Naval Architecture: Kernqualifikation: Compulsory

Course: Resistance and Propulsion (Vorlesung)

Lecturer:
Prof. Stefan Krüger

Language:
DE

Cycle:
WS

Content:

Literature:

Course: Resistance and Propulsion (Übung)

Lecturer:
Prof. Stefan Krüger

Language:
DE

Cycle:
WS

Content:

Literature:

Module: Hydrostatics and Body Plan

Courses:

Title	Typ	Hrs/wk
Hydrostatics	Vorlesung	2
Hydrostatics	Hörsaalübung	2
Body Plan	Projektseminar	2

Module Responsibility:
Prof. Stefan Krüger

Admission Requirements:

Recommended Previous Knowledge:

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Capabilities:

Personal Competence:
Social Competence:
Autonomy:

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 96, Study Time in Lecture: 84

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Naval Architecture: Compulsory
General Engineering Science (English program): Vertiefung Naval Architecture: Compulsory
Naval Architecture: Kernqualifikation: Compulsory

Course: Hydrostatics (Vorlesung)

Lecturer:
Prof. Stefan Krüger

Language:
DE

Cycle:
SS

Content:

Literature:

Course: Hydrostatics (Übung)

Lecturer:
Prof. Stefan Krüger

Language:
DE

Cycle:
SS

Content:

Literature:

Course: Body Plan (Projektseminar)

Lecturer:
Prof. Stefan Krüger

Language:
DE

Cycle:
WS

Content:

Literature:

Module: Ship Design

Courses:

Title	Typ	Hrs/wk
Ship Design	Vorlesung	2
Ship Design	Hörsaalübung	2

Module Responsibility:
Prof. Stefan Krüger

Admission Requirements:
Fluid Dynamics for Naval Architects, Resistance and Propulsion

Recommended Previous Knowledge:
Resistance and Propulsion, Hydrostatics

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The lecture starts with an overview about the importance and requirements of the aerly design phase. Competitive Elements of Ship Designs are thoroughly discussed. Typical bulding contracts and the related technical risk are introduced. The most important main parameters of a ship are introduced and their influence on the competitiveness of a design. The lecture focusses on the influence of alternated main parameters on the total performance of a ship design and the consecutive process elements. In this lecture, the design changes are dealt with by simple models or formulae. The student shall further learn to model complex systems properly so that the relavent technical conclusions can be drawn.
The lecture continues with an introduction into the different phases of design project, from the initial design phase to a building contract. Further, methods are introduced to generate bulding specfication relevant information at different levens of granularity during the different design stages. In detail, the following topics are adressed:

- Structure of a building specification
- Determination of Light Ship Weight and Deadweight Components
- Design of main section and hull form
- Design of aftbody lines and manoevering devices
- Design of main propulsion plant
- Design of subdivision
- Determination of limiting GMrequ- Curves
- Scantlings of most improtant structural members
- Longitudinal strength
- Outfitting Components
- Relevant rules and regulations

Capabilities:
The student is made familiar with the basic design principles of seagoing mearchant ships. The goal of the lecture is that the student shall be able to carry out a concept design based on a vessel of comparison fulfilling typical contract requirements within the Marine Environment. The lecture deals with the basic design methods to determine the fundamantal technical characteristics of a ship design with respect to fulfillment procedures of the contract values. Based on the lecture "Principles of Ship Design" the relevant methods to determine and judge uopn the performance of a ship design are treated.

Personal Competence:
Social Competence:
The students learns to prepare technical matters in such a way the he can persuade his potantial customer against his competitors.
Autonomy:
The students learns to prepare technical matters in such a way the he can persuade his potantial customer against his competitors.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Naval Architecture: Compulsory
General Engineering Science (English program): Vertiefung Naval Architecture: Compulsory
Naval Architecture: Kernqualifikation: Compulsory

Course: Ship Design (Vorlesung)

Lecturer:
Prof. Stefan Krüger

Language:
DE

Cycle:
SS

Content:

Literature:

Course: Ship Design (Übung)

Lecturer:
Prof. Stefan Krüger

Language:
DE

Cycle:
SS

Content:

Literature:

Specialisation Chemical Engineering

Module: Fundamentals of Process Engineering

Courses:

Title	Typ	Hrs/wk
Introduction into Process Engineering/Bioprocess Engineering	Vorlesung	2
Fundamentals of Technical Drawing and Materials	Vorlesung	1
Fundamentals of Technical Drawing and Materials	Hörsaalübung	1
Environmental Technologie	Vorlesung	2

Module Responsibility:
Prof. Michael Schlüter

Admission Requirements:
none

Recommended Previous Knowledge:
none

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
After passing this module the students have the ability to:

- give an overview of the most important fields on process and bioprocess engineering,
- explain some working methods for different fields in process engineering.

Capabilities:
After passing this module the students should have the ability to:

- list and outline the most important fields of process engineering,
- name the most important working approaches or methods of the different fields of process engineering,
- read and prepare an engineering drawing,
- explain the most important technologies for wastewater and exhaust air treatment
- scheme typical chemical and biotechnological processes independently with the aid of pointers.

Personal Competence:
Social Competence:
The students are able to

- work out results in groups and document them,
- provide appropriate feedback and handle feedback on their own performance constructively.

Autonomy:
The students are able to estimate their progress of learning by themselves and to deliberate their lack of knowledge in Process Engineering and Bioprocess Engineering.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 96, Study Time in Lecture: 84

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Chemical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Bioprocess Engineering: Compulsory
Bioprocess Engineering: Kernqualifikation: Compulsory

General Engineering Science (English program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (English program): Vertiefung Chemical Engineering: Compulsory
Technomathematics: Vertiefung Engineering Science: Compulsory suffrage
Process Engineering: Kernqualifikation: Compulsory

Course: Introduction into Process Engineering/Bioprocess Engineering (Vorlesung)

Lecturer:
Dozenten des SD V

Language:
DE

Cycle:
WS

Content:
Introduction into the different research fields of the subject Process Engineering and Bioprocess Engineering.

Literature:
s. StudIP

Course: Fundamentals of Technical Drawing and Materials (Vorlesung)

Lecturer:
Dr. Marko Hoffmann

Language:
DE

Cycle:
WS

Content:

- Technical drawing basics (contents, kinds of drawings and generation of drawings according to relevant standards)
- Projective geometry (basics, orthographic projections, isometric projections, cuts, developed views, penetration views)

Literature:

- Hesser, Wilfried; Hoischen, Hans: "Technisches Zeichnen", 33., überarb. und aktualisierte Aufl, Cornelsen Verlag, Berlin, 2011
- Labisch, Susanna; Weber, Christian: "Technisches Zeichnen", 4. überarbeitete und erweiterte Auflage, Springer Vieweg Verlag, Wiesbaden, 2013
- Kurz, Ulrich; Wittel, Herbert: "Böttcher/Forberg Technisches Zeichnen", 26. überarbeitete und erweiterte Auflage, Springer Vieweg Verlag, Wiesbaden, 2014

Course: Fundamentals of Technical Drawing and Materials (Übung)

Lecturer:
Dr. Marko Hoffmann

Language:
DE

Cycle:
WS

Content:

- Technical drawing basics (contents, kinds of drawings and generation of drawings according to relevant standards)
- Projective geometry (basics, orthographic projections, isometric projections, cuts, developed views, penetration views)

Literature:

- Hesser, Wilfried; Hoischen, Hans: "Technisches Zeichnen", 33., überarb. und aktualisierte Aufl, Cornelsen Verlag, Berlin, 2011
- Labisch, Susanna; Weber, Christian: "Technisches Zeichnen", 4. überarbeitete und erweiterte Auflage, Springer Vieweg Verlag,

Wiesbaden, 2013
- Kurz, Ulrich; Wittel, Herbert: "Böttcher/Forberg Technisches Zeichnen", 26. überarbeitete und erweiterte Auflage, Springer Vieweg Verlag, Wiesbaden, 2014

Course: Environmental Technologie (Vorlesung)

Lecturer:
Prof. Kerstin Kuchta, Dr. Wolfgang Ahlf

Language:
DE

Cycle:
WS

Content:

1. Introductory seminar on environmental science:
2. Environmental impact and adverse effects
3. Wastewater technology
4. Air pollution control
5. Noise protection
6. Waste and recycling management
7. Soil and ground water protection
8. Renewable energies
9. Resource conservation and energy efficiency

Literature:
Förster, U.: Umweltschutztechnik; 2012; Springer Berlin (Verlag) 8., Aufl. 2012; 978-3-642-22972-5 (ISBN)

Module: Physical Chemistry

Courses:

Title	Typ	Hrs/wk
Physical Chemistry	Vorlesung	2
Physical Chemistry	Laborpraktikum	2
Environmental Assessment	Vorlesung	2

Module Responsibility:
Prof. Raimund Horn

Admission Requirements:
Not applicable.

Recommended Previous Knowledge:
Contents of the previous modules inorganic chemistry, physics for engineers and mathematics I-III.

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students are able,
-to repeat the basic concepts of physical chemistry
-to describe and summarize the underlying concepts of mass-, heat- and momentum transfer.
- to interpret phase diagrams and affiliate kinetic rate laws.
Capabilities:
The students are able to
- conduct (fundamental) thermodynamical, electrochemical and kinetic calculations.
- assess new applications with respect to environmental sustainability.
- abstract their knowldege to related issues to conduct thermodynamical, electrochemical and kinetic calculations.

Personal Competence:
Social Competence:
The students are able to plan, prepare, conduct and document experiments according to scientific guidelines in small groups.
Autonomy:
Students are able to assess their knowldege continuously on their own by exemplified practice. Students are able to apply their knowldege discretely to plan, prepare and conduct experiments.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 96, Study Time in Lecture: 84

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Chemical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Chemical Engineering: Compulsory
Process Engineering: Kernqualifikation: Compulsory

Course: Physical Chemistry (Vorlesung)

Lecturer:
Prof. Hans-Ulrich Moritz

Language:
DE

Cycle:
WS

Content:
State variables and state equations, ideal and real gases, first law, driving force of chemical reactions, chemical equilibria, introduction into kinetics of chemical reactions, introduction into transport phenomena, phase equilibria, equilibria at surfaces and interfaces

Literature:
P. W. Atkins, J. de Paula: Physikalische Chemie, 5. Auflage, Wiley-VCH, 2013
P. W. Atkins, J. de Paula: Kurzlehrbuch Physikalische Chemie, 4. Auflage, Wiley-VCH, 2008
G. Wedler, H.-J. Freund: Lehrbuch der Physikalischen Chemie, 6. Auflage, Wiley-VCH, 2012
R. Reich: Thermodynamik - Grundlagen u. Anwendungen in der allgemeinen Chemie, 2. Auflage, Wiley-VCH, 1993
U. Nickel: Lehrbuch der Thermodynamik - Eine verständliche Einführung, 2. Auflage, PhysChem-Verlag, 2011

Course: Physical Chemistry (Laborpraktikum)

Lecturer:
Prof. Hans-Ulrich Moritz

Language:
DE

Cycle:
WS

Content:
Six laboratory experiments are conducted in groups of two students. The subjects of experimental investigations are:
Reaction kinetics
Freezing-point depression (cryoscopy)
Electrical mobility of ions
Viscosimetry
Heat of neutralization
Surface tension

Literature:
Skript zum Chemiepraktikum III für Verfahrenstechniker, jeweils aktuelle Version, ca. 100 Seiten, PDF-Datei zum Download unter http://www.chemie.uni-hamburg.de/studium/nebenfach/tuhh3/studium/nebenfach/tuhh3/studium/nebenfach/tuhh3/Praktikum_2013_2014.html

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Course: Environmental Assessment (Vorlesung)

Lecturer:
Prof. Martin Kaltschmitt, Dr. Wolfgang Ahlf, Jana Weinberg

Language:
DE/EN

Cycle:
SS

Content:
Contaminants: Impact- and Risk Assessment
Environmental damage & precautionary principle: Environmental Risk Assessment (ERA)
Resource and water consumption: Material flow analysis
Energy consumption: Cumulated energy demand (CED), cost analysis
Life cycle concept: Life cycle assessment (LCA)
Sustainability: Comprehensive product system assessment , SEE-Balance
Management: Environmental and Sustainability management (EMAS)
Complex systems: MCDA and scenario method

Literature:
Foliensätze der Vorlesung
Studie: **Instrumente zur Nachhaltigkeitsbewertung -** Eine Synopse (Forschungszentrum Jülich GmbH)

Courses:

Title	Typ	Hrs/wk
Fundamentals of Fluid Mechanics	Vorlesung	2
Exercises in Fluid Mechanics for Process Engineering	Hörsaalübung	1

Module Responsibility:
Prof. Michael Schlüter

Admission Requirements:

- Mathematics I+II+III
- Technical Mechanics I+II
- Technical Thermodynamics I+II

Recommended Previous Knowledge:

- Working with force balances
- Simplification and solving of partial differential equations
- Integration

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students are able to:

- explain the difference between different types of flow
- give an overview for different applications of the Reynolds Transport-Theorem in process engineering
- explain simplifications of the Continuity- and Navier-Stokes-Equation by using physical boundary conditions

Capabilities:
The students are able to

- describe and model incompressible flows mathematically
- reduce the governing equations of fluid mechanics by simplifications to archive quantitative solutions e.g. by integration
- notice the dependency between theory and technical applications
- use the learned basics for fluid dynamical applications in fields of process engineering

Personal Competence:
Social Competence:
The students

- are capable to gather information from subject related, professional publications and relate that information to the context of the lecture and
- able to work together on subject related tasks in small groups. They are able to present their results effectively in English (e.g. during small group exercises)

Autonomy:
The students are able to

- search further literature for each topic and to expand their knowledge with this literature,
- work on their exercises by their own and to evaluate their actual knowledge with the feedback.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 138, Study Time in Lecture: 42

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Chemical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (German program): Vertiefung Energy and Enviromental Engineering: Compulsory
Bioprocess Engineering: Kernqualifikation: Compulsory
Energy and Environmental Engineering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (English program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (English program): Vertiefung Chemical Engineering: Compulsory
Technomathematics: Vertiefung Engineering Science: Compulsory suffrage

Course: Fundamentals of Fluid Mechanics (Vorlesung)

Lecturer:
Prof. Michael Schlüter

Language:
DE

Cycle:
SS

Content:

- fluid properties
- hydrostatic
- overall balances - theory of streamline
- overall balances- conservation equations
- differential balances - Navier Stokes equations
- irrotational flows - Potenzialströmungen
- flow around bodies - theory of physical similarity
- turbulent flows
- compressible flows

Literature:

1. Crowe, C. T.: Engineering fluid mechanics. Wiley, New York, 2009.
2. Durst, F.: Strömungsmechanik: Einführung in die Theorie der Strömungen von Fluiden. Springer-Verlag, Berlin, Heidelberg, 2006.
3. Fox, R.W.; et al.: Introduction to Fluid Mechanics. J. Wiley & Sons, 1994
4. Herwig, H.: Strömungsmechanik: Eine Einführung in die Physik und die mathematische Modellierung von Strömungen. Springer Verlag, Berlin, Heidelberg, New York, 2006
5. Herwig, H.: Strömungsmechanik: Einführung in die Physik von technischen Strömungen: Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008
6. Kuhlmann, H.C.: Strömungsmechanik. München, Pearson Studium, 2007
7. Oertl, H.: Strömungsmechanik: Grundlagen, Grundgleichungen, Lösungsmethoden, Softwarebeispiele. Vieweg+ Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2009
8. Schade, H.; Kunz, E.: Strömungslehre. Verlag de Gruyter, Berlin, New York, 2007
9. Truckenbrodt, E.: Fluidmechanik 1: Grundlagen und elementare Strömungsvorgänge dichtebeständiger Fluide. Springer-Verlag, Berlin, Heidelberg, 2008
10. Schlichting, H. : Grenzschicht-Theorie. Springer-Verlag, Berlin, 2006
11. van Dyke, M.: An Album of Fluid Motion. The Parabolic Press, Stanford California, 1882.
12. White, F.: Fluid Mechanics, Mcgraw-Hill, ISBN-10: 0071311211, ISBN-13: 978-0071311212, 2011

Course: Exercises in Fluid Mechanics for Process Engineering (Übung)

Lecturer:
Prof. Michael Schlüter

Language:
DE

Cycle:
SS

Content:
The Exercise-Lecture will bridge the gap between the theoretical content from the lecture and the practical calculations for the homework exercises. For this aim a special exercise is calculated at the blackboard that shows how the theoretical knowledge from the lecture can be used to solve real problems in Process Engineering.

Literature:

1. Crowe, C. T.: Engineering fluid mechanics. Wiley, New York, 2009.
2. Durst, F.: Strömungsmechanik: Einführung in die Theorie der Strömungen von Fluiden. Springer-Verlag, Berlin, Heidelberg, 2006.
3. Fox, R.W.; et al.: Introduction to Fluid Mechanics. J. Wiley & Sons, 1994
4. Herwig, H.: Strömungsmechanik: Eine Einführung in die Physik und die mathematische Modellierung von Strömungen. Springer Verlag, Berlin, Heidelberg, New York, 2006
5. Herwig, H.: Strömungsmechanik: Einführung in die Physik von technischen Strömungen: Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008
6. Kuhlmann, H.C.: Strömungsmechanik. München, Pearson Studium, 2007
7. Oertl, H.: Strömungsmechanik: Grundlagen, Grundgleichungen, Lösungsmethoden, Softwarebeispiele. Vieweg+ Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2009
8. Schade, H.; Kunz, E.: Strömungslehre. Verlag de Gruyter, Berlin, New York, 2007
9. Truckenbrodt, E.: Fluidmechanik 1: Grundlagen und elementare Strömungsvorgänge dichtebeständiger Fluide. Springer-Verlag,

Berlin, Heidelberg, 2008
10. Schlichting, H. : Grenzschicht-Theorie. Springer-Verlag, Berlin, 2006
11. van Dyke, M.: An Album of Fluid Motion. The Parabolic Press, Stanford California, 1882.
12. White, F.: Fluid Mechanics, Mcgraw-Hill, ISBN-10: 0071311211, ISBN-13: 978-0071311212, 2011

Courses:

Title	Typ	Hrs/wk
Thermodynamics III	Vorlesung	2
Thermodynamics III	Gruppenübung	1
Thermodynamics III	Hörsaalübung	1

Module Responsibility:
Prof. Irina Smirnova

Admission Requirements:

Recommended Previous Knowledge:
Mathematics, Physical Chemistry, Thermodynamics I and II

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:

- Starting from the very basics of thermodynamics, the students learn the mathematical tools to describe thermodynamic equilibria.
- They learn how state variables are influenced by the mixing of compounds and learn concepts to quantitatively describe these properties.
- Moreover, the students learn how phase equilibria can be described mathematically and which phenomena may occur if different phases (vapor, liquid, solid) coexist in equilibrium. Furthermore the fundamentals of reaction equilibria are taught.
- For different phase equilibria, several examples relevant for different kinds of processes are shown and the necessary knowledge for plotting and interpreting the equilibria are taught.

Capabilities:

- Applying their knowledge, the students are able to identify the correct equation for the determination of the equilibrium state and know how to simplify these equations meaningfully.
- The students know models which can be used to determine the properties of the system in the equilibrium state and they are able to solve the resulting mathematical relations.
- For specific applications, they are able to self-reliantly find necessary physico-chemical properties of compounds as well as model parameters in literature sources.
- Beside pure compound properties the students are capable of describing the properties of mixtures.
- The students know how to visualize phase equilibria graphically and they know how to interpret the occurring phenomena.
- Based on their knowledge, the students are able to understand fundamental concepts that are the basis for many separation and reaction processes in chemical engineering.

Personal Competence:
Social Competence:
Autonomy:

- The students are able to find necessary information self-reliantly in literature sources and to judge their quality.
- During the semester the students are able to check their learning progress continuously in exercises. Based on this knowledge the students can adept their learning process.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Chemical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Bioprocess Engineering: Compulsory
Bioprocess Engineering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (English program): Vertiefung Chemical Engineering: Compulsory
Process Engineering: Kernqualifikation: Compulsory

Course: Thermodynamics III (Vorlesung)

Lecturer:
Prof. Irina Smirnova

Language:
DE

Cycle:
SS

Content:

1. Introduction: Applications of thermodynamics of mixtures
2. Thermodynamic equations in multi-component systems: Fundamental equations, chemical potential, fugacity
3. Phase equilibria of pure substances: thermodynamic equilibrium, vapor pressure, Gibbs' phase rule
4. Equations of state: virial equations, van-der-Waals equation, generalized equations of state
5. Mixing properties: ideal and real mixtures, excess properties, partial molar properties
6. Vapor-liquid-equilibria: binary systems, azeotropes, equilibrium condition
7. Gas-liquid-equilibria: equilibrium condition, Henry-coefficient
8. G^E-Models: Hildebrand-model, Flory-Huggins-model, Wilson-model, UNIQUAC, UNIFAC
9. Liquid-liquid-equilibria: equilibrium condition, phase equilibria in binary and ternary systems
10. Solid-liquid-equilibria: equilibrium condition, binary systems
11. Chemical reactions: reaction coordinate, mass action law, influence of pressure and temperature
12. Osmotic pressure

Literature:

- Jürgen Gmehling, Bärbel Kolbe: Thermodynamik. VCH 1992
- J.M. Prausnitz, R.N. Lichtenthaler, E.G. de Azevedo: Molecular Thermodynamics of Fluid-Phase Equilibria, 3rd ed. Prentice Hall, 1999.
- J.W. Tester, M. Modell: Thermodynamics and its Applications. 3rd ed. Prentice Hall, 1997.J.P. O´Connell, J.M. Haile: Thermodynamics. Cambridge University Press, 2005.

Course: Thermodynamics III (Übung)

Lecturer:
Prof. Irina Smirnova

Language:
DE

Cycle:
SS

Content:

1. Introduction: Applications of thermodynamics of mixtures
2. Thermodynamic equations in multi-component systems: Fundamental equations, chemical potential, fugacity
3. Phase equilibria of pure substances: thermodynamic equilibrium, vapor pressure, Gibbs' phase rule
4. Equations of state: virial equations, van-der-Waals equation, generalized equations of state
5. Mixing properties: ideal and real mixtures, excess properties, partial molar properties
6. Vapor-liquid-equilibria: binary systems, azeotropes, equilibrium condition
7. Gas-liquid-equilibria: equilibrium condition, Henry-coefficient
8. G^E-Models: Hildebrand-model, Flory-Huggins-model, Wilson-model, UNIQUAC, UNIFAC
9. Liquid-liquid-equilibria: equilibrium condition, phase equilibria in binary and ternary systems
10. Solid-liquid-equilibria: equilibrium condition, binary systems
11. Chemical reactions: reaction coordinate, mass action law, influence of pressure and temperature
12. Osmotic pressure

Literature:

- Jürgen Gmehling, Bärbel Kolbe: Thermodynamik. VCH 1992
- J.M. Prausnitz, R.N. Lichtenthaler, E.G. de Azevedo: Molecular Thermodynamics of Fluid-Phase Equilibria, 3rd ed. Prentice Hall, 1999.
- J.W. Tester, M. Modell: Thermodynamics and its Applications. 3rd ed. Prentice Hall, 1997.J.P. O´Connell, J.M. Haile: Thermodynamics. Cambridge University Press, 2005.

Course: Thermodynamics III (Übung)

Lecturer:
Prof. Irina Smirnova

Language:
DE

Cycle:
SS

Content:

1. Introduction: Applications of thermodynamics of mixtures
2. Thermodynamic equations in multi-component systems: Fundamental equations, chemical potential, fugacity
3. Phase equilibria of pure substances: thermodynamic equilibrium, vapor pressure, Gibbs' phase rule
4. Equations of state: virial equations, van-der-Waals equation, generalized equations of state
5. Mixing properties: ideal and real mixtures, excess properties, partial molar properties
6. Vapor-liquid-equilibria: binary systems, azeotropes, equilibrium condition
7. Gas-liquid-equilibria: equilibrium condition, Henry-coefficient
8. G^E-Models: Hildebrand-model, Flory-Huggins-model, Wilson-model, UNIQUAC, UNIFAC
9. Liquid-liquid-equilibria: equilibrium condition, phase equilibria in binary and ternary systems
10. Solid-liquid-equilibria: equilibrium condition, binary systems
11. Chemical reactions: reaction coordinate, mass action law, influence of pressure and temperature
12. Osmotic pressure

Literature:

- Jürgen Gmehling, Bärbel Kolbe: Thermodynamik. VCH 1992
- J.M. Prausnitz, R.N. Lichtenthaler, E.G. de Azevedo: Molecular Thermodynamics of Fluid-Phase Equilibria, 3rd ed. Prentice Hall, 1999.
- J.W. Tester, M. Modell: Thermodynamics and its Applications. 3rd ed. Prentice Hall, 1997.J.P. O´Connell, J.M. Haile: Thermodynamics. Cambridge University Press, 2005.

Module: Signals and Systems

Courses:

Title	Typ	Hrs/wk
Signals and Systems	Vorlesung	3
Signals and Systems	Hörsaalübung	1

Module Responsibility:
Prof. Gerhard Bauch

Admission Requirements:
Mathematics 1-3

Recommended Previous Knowledge:

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students are able to classify and describe signals and linear time-invariant (LTI) systems using methods of signal and system theory. They are able to apply the fundamental transformations of continuous-time and discrete-time signals and systems. They can describe and analyse deterministic signals and systems mathematically in both time and image domain. In particular, they understand the effects in time domain and image domain which are caused by the transition of a continuous-time signal to a discrete-time signal.
Capabilities:
The students are able to describe and analyse deterministic signals and linear time-invariant systems using methods of signal and system theory. They can analyse and design basic systems regarding important properties such as magnitude and phase response, stability, linearity etc.. They can assess the impact of LTI systems on the signal properties in time and frequency domain.

Personal Competence:
Social Competence:
The students can jointly solve specific problems.
Autonomy:
The students are able to acquire relevant information from appropriate literature sources. They can control their level of knowledge during the lecture period by solving tutorial problems, software tools, clicker system.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Electrical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Computer Science and Engineering: Compulsory
General Engineering Science (German program): Vertiefung Chemical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (German program): Vertiefung Civil- and Enviromental Engeneering: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Biomedical Engineering: Compulsory
Computer Science: Kernqualifikation: Compulsory
Electrical Engineering: Kernqualifikation: Compulsory
Electrical Engineering myTrack: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Civil- and Enviromental Engeneering: Compulsory
General Engineering Science (English program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (English program): Vertiefung Electrical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Computer Science and Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Chemical Engineering: Compulsory
Computational Science and Engineering: Kernqualifikation: Compulsory
Mechatronics: Kernqualifikation: Compulsory
Technomathematics: Vertiefung Engineering Science: Compulsory suffrage

Course: Signals and Systems (Vorlesung)

Lecturer:
Prof. Gerhard Bauch

Language:
DE/EN

Cycle:
SS

Content:

- Basic classification and description of continuous-time and discrete-time signals and systems
- Concvolution
- Power and energy of signals
- Correlation functions of deterministic signals
- Linear time-invariant (LTI) systems
- Signal transformations:
  - Fourier-Series
  - Fourier Transform
  - Laplace Transform
  - Discrete-time Fourier Transform
  - Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT)
  - Z-Transform
- Analysis and design of LTI systems in time and frequency domain
- Basic filter types
- Sampling, sampling theorem
- Fundamentals of recursive and non-recursive discrete-time filters

Literature:

- T. Frey , M. Bossert , Signal- und Systemtheorie, B.G. Teubner Verlag 2004
- K. Kammeyer, K. Kroschel, Digitale Signalverarbeitung, Teubner Verlag.
- B. Girod ,R. Rabensteiner , A. Stenger , Einführung in die Systemtheorie, B.G. Teubner, Stuttgart, 1997
- J.R. Ohm, H.D. Lüke , Signalübertragung, Springer-Verlag 8. Auflage, 2002
- S. Haykin, B. van Veen: Signals and systems. Wiley.
- Oppenheim, A.S. Willsky: Signals and Systems. Pearson.
- Oppenheim, R. W. Schafer: Discrete-time signal processing. Pearson.

Course: Signals and Systems (Übung)

Lecturer:
Prof. Gerhard Bauch

Language:
DE/EN

Cycle:
SS

Content:

- Basic classification and description of continuous-time and discrete-time signals and systems
- Concvolution
- Power and energy of signals
- Correlation functions of deterministic signals
- Linear time-invariant (LTI) systems
- Signal transformations:
  - Fourier-Series
  - Fourier Transform
  - Laplace Transform
  - Discrete-time Fourier Transform
  - Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT)
  - Z-Transform
- Analysis and design of LTI systems in time and frequency domain
- Basic filter types
- Sampling, sampling theorem
- Fundamentals of recursive and non-recursive discrete-time filters

Literature:

- T. Frey , M. Bossert , Signal- und Systemtheorie, B.G. Teubner Verlag 2004
- K. Kammeyer, K. Kroschel, Digitale Signalverarbeitung, Teubner Verlag.
- B. Girod ,R. Rabensteiner , A. Stenger , Einführung in die Systemtheorie, B.G. Teubner, Stuttgart, 1997
- J.R. Ohm, H.D. Lüke , Signalübertragung, Springer-Verlag 8. Auflage, 2002
- S. Haykin, B. van Veen: Signals and systems. Wiley.
- Oppenheim, A.S. Willsky: Signals and Systems. Pearson.
- Oppenheim, R. W. Schafer: Discrete-time signal processing. Pearson.

Module: Practical Training in Process Engineering

Courses:

Title	Typ	Hrs/wk
Practical Training in Measurement Techniques	Laborpraktikum	3
Measurement Methods in Process Engineering	Vorlesung	2

Module Responsibility:
Prof. Michael Schlüter

Admission Requirements:
none

Recommended Previous Knowledge:
Undergraduate lectures of mathematics and physics

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The Students are able to describe the usual measurement techniques and measurement methods in process engineering and to describe their fields of applications.
Capabilities:
The students are able to use different measurement technologies in Process Engineering and Bioprocess Engineering at experimental facilities. They are able to evaluate the measured data result-oriented and to estimate the accuracy of the measurements.

Personal Competence:
Social Competence:
The students are able to discuss a given problem in small groups and to develop and present an approach.
Autonomy:
The students are able to implement measurement techniques by themselves and to develop a program for the measurements.

ECTS-Credit points:
6 LP

Examination:
Schriftliche Ausarbeitung

Workload in Hours:
Indipendent Study Time: 110, Study Time in Lecture: 70

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Chemical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Chemical Engineering: Compulsory
Process Engineering: Kernqualifikation: Compulsory

Course: Practical Training in Measurement Techniques (Laborpraktikum)

Lecturer:
Prof. Michael Schlüter, Dozenten des SD E, Dozenten des SD B, Dozenten des SD V, Dozenten des SD M

Language:
DE

Cycle:
SS

Content:
Several practical courses concerning measurement technologies are given by the different Instituts of the department Process Engineering and Bioprocess Engineering.

Literature:
Individual or each practical course

Course: Measurement Methods in Process Engineering (Vorlesung)

Lecturer:
Prof. Michael Schlüter

Language:
DE

Cycle:
WS

Content:

1 Fundamentals
1.1 Quantities and Units
1.2 Uncertainty
1.3 Calibration
1.4 Static and Dynamic Properties of Sensors and Systems
2 Measurement of Electrical Quantities
2.1 Current and Voltage
2.2 Impedance
2.3 Amplification
2.4 Oscilloscope
2.5 Analog-to-Digital Conversion
2.6 Data Transmission
3 Measurement of Nonelectric Quantities
3.1 Temperature
3.2 Length, Displacement, Angle
3.3 Strain, Force, Pressure
3.4 Flow
3.5 Time, Frequency
4 Chemical Analysis
4.1 Gas Sensors
4.2 Spectroscopy
4.3 Gas Chromatography

Literature:

- Lerch, R.: „Elektrische Messtechnik; Analoge, digitale und computergestützte Verfahren“, Springer, 2006, ISBN: 978-3-540-34055-3.
- Profos, P. Pfeifer, T.: „Handbuch der industriellen Messtechnik“, Oldenbourg, 2002, ISBN: 978-3486217940.

Module: Bioprocess Engineering - Fundamentals

Courses:

Title	Typ	Hrs/wk
Bioprocess Engineering - Fundamentals	Vorlesung	2
Bioprocess Engineering- Fundamentals	Hörsaalübung	2
Bioprocess Engineering - Fundamental Practical Course	Laborpraktikum	2

Module Responsibility:
Prof. Andreas Liese

Admission Requirements:
none

Recommended Previous Knowledge:
none, module "organic chemistry", module "fundamentals for process engineering"

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students are able to describe the basic concepts of bioprocess engineering. They are able to classify different types of kinetics for enzymes and microorganisms, as well as to differentiate different types of inhibition. The parameters of stoichiometry and rheology can be named and mass transport processes in bioreactors can be explained. The students are capable to explain fundamental bioprocess management, sterilization technology and downstream processing in detail.
Capabilities:
After successful completion of this module, students should be able to

- describe different kinetic approaches for growth and substrate-uptake and to calculate the corresponding parameters
- predict qualitatively the influence of energy generation, regeneration of redox equivalents and growth inhibition on the fermentation process
- analyze bioprocesses on basis of stoichiometry and to set up / solve metabolic flux equations
- distinguish between scale-up criteria for different bioreactors and bioprocesses (anaerobic, aerobic as well as microaerobic) to compare them as well as to apply them to current biotechnical problem
- propose solutions to complicated biotechnological problems and to deduce the corresponding models

- to explore new knowledge resources and to apply the newly gained contents
- identify scientific problems with concrete industrial use and to formulate solutions.

Personal Competence:
Social Competence:
After completion of this module participants should be able to debate technical questions in small teams to enhance the ability to take position to their own opinions and increase their capacity for teamwork in engineering and scientific environments.
Autonomy:
After completion of this module participants will be able to solve a technical problem in a team independently by organizing their workflow and to present their results in aplenum.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 96, Study Time in Lecture: 84

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Chemical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Bioprocess Engineering: Compulsory
Bioprocess Engineering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (English program): Vertiefung Chemical Engineering: Compulsory
Technomathematics: Vertiefung Engineering Science: Compulsory suffrage
Process Engineering: Kernqualifikation: Compulsory

Course: Bioprocess Engineering - Fundamentals (Vorlesung)

Lecturer:
Prof. Andreas Liese, Prof. An-Ping Zeng

Language:
DE

Cycle:
SS

Content:

- Introduction: state-of-the-art and development trends in the biotechnology, introduction to the lecture
- Enzyme kinetics: Michaelis-Menten, differnt types of enzyme inhibition, linearization, conversion, yield, selectivity (Prof. Liese)
- Stoichiometry: coefficient of respiration, electron balance, degree of reduction, coefficient of yield, theoretical oxygen demand (Prof. Liese)
- Microbial growth kinetic: batch- and chemostat culture (Prof. Zeng)
- Kinetic of subtrate consumption and product formation (Prof. Zeng)
- Rheology: non-newtonian fluids, viscosity, agitators, energy input (Prof. Liese)
- Transport process in a bioreactor (Prof. Zeng)
- Technology of sterilization (Prof. Zeng)
- Fundamentals of bioprocess management: bioreactors and calculation of batch, fed-batch and continuouse bioprocesses (Prof. Zeng/Prof. Liese)
- Downstream technology in biotechnology: cell breakdown, zentrifugation, filtration, aqueous two phase systems (Prof. Liese)

Literature:
K. Buchholz, V. Kasche, U. Bornscheuer: Biocatalysts and Enzyme Technology, 2. Aufl. Wiley-VCH, 2012
H. Chmiel: Bioprozeßtechnik, Elsevier, 2006
R.H. Balz et al.: Manual of Industrial Microbiology and Biotechnology, 3. edition, ASM Press, 2010
H.W. Blanch, D. Clark: Biochemical Engineering, Taylor & Francis, 1997
P. M. Doran: Bioprocess Engineering Principles, 2. edition, Academic Press, 2013

Course: Bioprocess Engineering- Fundamentals (Übung)

Lecturer:
Prof. Andreas Liese, Prof. An-Ping Zeng

Language:
DE

Cycle:
SS

Content:
1. Introduction (Prof. Liese, Prof. Zeng)
2. Enzymatic kinetics (Prof. Liese)
3. Stoichiometry I + II (Prof. Liese)
4. Microbial Kinetics I+II (Prof. Zeng)
5. Rheology (Prof. Liese)
6. Mass transfer in bioprocess (Prof. Zeng)
7. Continuous culture (Chemostat) (Prof. Zeng)
8. Sterilisation (Prof. Zeng)
9. Downstream processing (Prof. Liese)
10. Repetition (Reserve) (Prof. Liese, Prof. Zeng)

Literature:
siehe Vorlesung

Course: Bioprocess Engineering - Fundamental Practical Course (Laborpraktikum)

Lecturer:
Prof. Andreas Liese, Prof. An-Ping Zeng

Language:
DE

Cycle:
SS

Content:
In this course fermentation and downstream technologies on the example of the production of an enzyme by means of a recombinant microorganism is learned. Detailed characterization and simulation of enzyme kinetics as well as application of the enzyme in a bioreactor is carried out.

Literature:
Skript

Courses:

Title	Typ	Hrs/wk
Heat and Mass Transfer	Vorlesung	2
Heat and Mass Transfer	Gruppenübung	1

Module Responsibility:
Prof. Irina Smirnova

Admission Requirements:

Recommended Previous Knowledge:
Basic knowledge: Technical Thermodynamics

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:

- The students are capable of explaining qualitative and determining quantitative heat transfer in procedural apparatus (e. g. heat exchanger, chemical reactors).
- They are capable of distinguish and characterize different kinds of heat transfer mechanisms namely heat conduction, heat transfer and thermal radiation.
- The students have the ability to explain the physical basis for mass transfer in detail and to describe mass transfer qualitative and quantitative by using suitable mass transfer theories.
- They are able to depict the analogy between heat- and mass transfer and to describe complex linked processes in detail.

Capabilities:

- The students are able to set reasonable system boundaries for a given transport problem by using the gained knowledge and to balance the corresponding energy and mass flow, respectively.
- They are capable to solve specific heat transfer problems (e.g. heated chemical reactors, temperature alteration in fluids) and to calculate the corresponding heat flows.
- Using dimensionless quantities, the students can execute scaling up of technical processes or apparatus.
- They are able to distinguish between diffusion, convective mass transition and mass transfer. They can use this knowledge for the description and design of apparatus (e.g. extraction column, rectification column).
- In this context, the students are capable to choose and design fundamental types of heat and mass exchanger for a specific application considering their advantages and disadvantages, respectively.
- In addition, they can calculate both, steady-state and non-steady-state processes in procedural apparatus.
- The students are capable to connect their knowledge obtained in this course with knowlegde of other courses (In particular the courses thermodynamics, fluid mechanics and chemical process engineering) to solve concrete technical problems.

Personal Competence:
Social Competence:

- The students are capable to work on subject-specific challenges in teams and to present the results in a reasonable manner.

Autonomy:

- The students are able to find and evaluate necessary information from suitable sources
- They are able to prove their level of knowledge during the course with accompanying procedure continuously (clicker-system, exam-like assignments) and on this basis they can control their learning processes.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 138, Study Time in Lecture: 42

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Chemical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (German program): Vertiefung Energy and Enviromental Engineering: Compulsory

Bioprocess Engineering: Kernqualifikation: Compulsory
Energy and Environmental Engineering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (English program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (English program): Vertiefung Chemical Engineering: Compulsory
Technomathematics: Kernqualifikation: Compulsory suffrage
Process Engineering: Kernqualifikation: Compulsory

Course: Heat and Mass Transfer (Vorlesung)

Lecturer:
Prof. Irina Smirnova

Language:
DE

Cycle:
WS

Content:

1. Heat transfer
    - Introduction, one-dimensional heat conduction
    - Convective heat transfer
    - Multidimensional heat conduction
    - Non-steady heat conduction
    - Thermal radiation
2. Mass transfer
    - one-way diffusion, equimolar countercurrent diffusion
    - boundary layer theory, non-steady mass transfer
    - Heat and mass transfer single particle/ fixed bed
    - Mass transfer and chemical reactions

Literature:

1. H.D. Baehr und K. Stephan: Wärme- und Stoffübertragung, Springer
2. VDI-Wärmeatlas

Course: Heat and Mass Transfer (Übung)

Lecturer:
Prof. Irina Smirnova

Language:
DE

Cycle:
WS

Content:

1. Heat transfer
    - Introduction, one-dimensional heat conduction
    - Convective heat transfer
    - Multidimensional heat conduction
    - Non-steady heat conduction
    - Thermal radiation
2. Mass transfer
    - one-way diffusion, equimolar countercurrent diffusion
    - boundary layer theory, non-steady mass transfer
    - Heat and mass transfer single particle/ fixed bed
    - Mass transfer and chemical reactions

Literature:

1. H.D. Baehr und K. Stephan: Wärme- und Stoffübertragung, Springer
2. VDI-Wärmeatlas

Courses:

Title	Typ	Hrs/wk
Thermal Separation Processes	Vorlesung	3
Thermal Separation Processes	Gruppenübung	2
Thermal Separation Processes	Hörsaalübung	1
Separation Processes	Laborpraktikum	1

Module Responsibility:
Prof. Irina Smirnova

Admission Requirements:
Recommended requirements: Thermodynamics III (not compulsory)

Recommended Previous Knowledge:
Recommended requirements: Thermodynamics III

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:

- The students develop an understanding of separation processes of fluid mixtures
- They can distinguish and describe different types of separation processes such as distillation, extraction or adsorption
- The students have good knowledge of designing methods for separation processes and devices
- The students develop an understanding for the course of concentration changes during a separation process, the estimation of the energy demand of a process, the possibilities of energy saving and the selection of separation systems

Capabilities:

- Using the gained knowledge the students can select a reasonable system boundary for a given separation process and can close the associated energy and material balances
- The students can use different graphical methods for the designing of a separation process and define the amount of theoretical stages required
- They can select and design a basic type of thermal separation process for a given case based on the advantages and disadvantages of the process
- The students are capable to obtain independently the needed material properties from appropriate sources (diagrams and tables)
- They can calculate continuous and discontinuous processes

The students are capable of linking their gained knowledge with the content of other lectures and use it together for the solution of technical problems. Other lectures such as thermodynamics, fluid mechanics and chemical engineering.

Personal Competence:
Social Competence:

- The students can work technical assignments in small groups and present the combined results in the tutorial

Autonomy:

- The students are capable to obtain the needed information from suitable sources by themselves and assess their quality
- The students can proof the state of their knowledge with exam resembling assignments and in this way control their learning process

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 82, Study Time in Lecture: 98

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Chemical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (German program): Vertiefung Energy and Enviromental Engineering: Compulsory
Bioprocess Engineering: Kernqualifikation: Compulsory

Energy and Environmental Engineering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (English program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (English program): Vertiefung Chemical Engineering: Compulsory
Process Engineering: Kernqualifikation: Compulsory

Course: Thermal Separation Processes (Vorlesung)

Lecturer:
Prof. Irina Smirnova

Language:
DE

Cycle:
WS

Content:

- Introduction in the thermal process engineering and to the main features of separation processes
- Simple equilibrium processes, several steps processes
- Distillation of binary mixtures, enthalpy-concentration diagrams
- Extractive and azeotrope distillation, water vapor distillation, stepwise distillation
- Extraction: separation ternary systems, ternary diagram
- Multiphase separation including complex mixtures
- Designing of separation devices without discrete stages
- Drying
- Chromatographic separation processes
- Membrane separation
- Energy demand of separation processes
- Advance overview of separation processes
- Selection of separation processes

Literature:

- G. Brunner: Skriptum Thermische Verfahrenstechnik
- J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980
- Sattler: Thermische Trennverfahren, VCH, Weinheim 1995
- J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998.
- Mersmann: Thermische Verfahrenstechnik, Springer, 1980
- Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997
- Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1 ; ISBN 0-387-91477-3 .
- R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006.
    - Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed., McGraw-Hill, New York 1984 Ullmann"s Enzyklopädie der Technischen Chemie

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Course: Thermal Separation Processes (Übung)

Lecturer:
Prof. Irina Smirnova

Language:
DE

Cycle:
WS

Content:

- Introduction in the thermal process engineering and to the main features of separation processes
- Simple equilibrium processes, several steps processes
- Distillation of binary mixtures, enthalpy-concentration diagrams
- Extractive and azeotrope distillation, water vapor distillation, stepwise distillation
- Extraction: separation ternary systems, ternary diagram
- Multiphase separation including complex mixtures
- Designing of separation devices without discrete stages
- Drying
- Chromatographic separation processes
- Membrane separation
- Energy demand of separation processes
- Advance overview of separation processes

- Selection of separation processes

Literature:

- G. Brunner: Skriptum Thermische Verfahrenstechnik
- J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980
- Sattler: Thermische Trennverfahren, VCH, Weinheim 1995
- J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998.
- Mersmann: Thermische Verfahrenstechnik, Springer, 1980
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- Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1 ; ISBN 0-387-91477-3 .
- R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006.
- Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed., McGraw-Hill, New York 1984 Ullmann"s Enzyklopädie der Technischen Chemie

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Course: Thermal Separation Processes (Übung)

Lecturer:
Prof. Irina Smirnova

Language:
DE

Cycle:
WS

Content:

- Introduction in the thermal process engineering and to the main features of separation processes
- Simple equilibrium processes, several steps processes
- Distillation of binary mixtures, enthalpy-concentration diagrams
- Extractive and azeotrope distillation, water vapor distillation, stepwise distillation
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Literature:

- G. Brunner: Skriptum Thermische Verfahrenstechnik
- J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980
- Sattler: Thermische Trennverfahren, VCH, Weinheim 1995
- J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998.
- Mersmann: Thermische Verfahrenstechnik, Springer, 1980
- Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997
- Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1 ; ISBN 0-387-91477-3 .
- R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006.
- Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed., McGraw-Hill, New York 1984 Ullmann"s Enzyklopädie der Technischen Chemie

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Course: Separation Processes (Laborpraktikum)

Lecturer:
Prof. Irina Smirnova

Language:
DE/EN

Cycle:
SS

Content:

- Introduction in the thermal process engineering and to the main features of separation processes
- Simple equilibrium processes, several steps processes
- Distillation of binary mixtures, enthalpy-concentration diagrams
- Extractive and azeotrope distillation, water vapor distillation, stepwise distillation
- Extraction: separation ternary systems, ternary diagram
- Multiphase separation including complex mixtures
- Designing of separation devices without discrete stages
- Drying
- Chromatographic separation processes
- Membrane separation
- Energy demand of separation processes
- Advance overview of separation processes
- Selection of separation processes

Literature:

- G. Brunner: Skriptum Thermische Verfahrenstechnik
- J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980
- Sattler: Thermische Trennverfahren, VCH, Weinheim 1995
- J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998.
- Mersmann: Thermische Verfahrenstechnik, Springer, 1980
- Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997
- Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1 ; ISBN 0-387-91477-3 .
- R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006.
- Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed., McGraw-Hill, New York 1984 Ullmann"s Enzyklopädie der Technischen Chemie

Module: Chemical Reaction Engineering

Courses:

Title	Typ	Hrs/wk
Chemical Reaction Engineering (Fundamentals)	Vorlesung	2
Chemical Reaction Engineering (Fundamentals)	Hörsaalübung	2
Experimental Course Chemical Engineering (Fundamentals)	Laborpraktikum	2

Module Responsibility:
Prof. Raimund Horn

Admission Requirements:
Not applicable

Recommended Previous Knowledge:
Contents of the previous modules mathematics I-III, physical chemistry, technical thermodynamics I+II as well as computational methods for engineers.

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students are able to explain basic concepts of chemical reaction engineering. They are able to point out differences between thermodynamical and kinetical processes. The students have a strong ability to outline parts of isothermal and non-isothermal ideal reactors and to describe their properties.
Capabilities:
After successful completion of the module, students are able to:
- apply different computational methods to dimension isothermal and non-isothermal ideal reactors,
- determine and compute stable operation points for these reactors ,
- conduct experiments on a lab-scale pilot plants and document these according to scientific guidelines.

Personal Competence:
Social Competence:
After successful completition of the lab-course the students have a strong ability to organize themselfes in small groups to solve issues in chemical reaction engineering.
Autonomy:
The students are able to obtain further information and assess their relevance autonomously. Students can apply their knowldege discretely to plan, prepare and conduct experiments.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 96, Study Time in Lecture: 84

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Chemical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Bioprocess Engineering: Compulsory
Bioprocess Engineering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (English program): Vertiefung Chemical Engineering: Compulsory
Process Engineering: Kernqualifikation: Compulsory

Course: Chemical Reaction Engineering (Fundamentals) (Vorlesung)

Lecturer:
Prof. Raimund Horn

Language:
DE

Cycle:
WS

Content:
Fundamentals of chemical reaction engineering, definitions, calculation of species concentrations (reactor, reaction mixture, reactants, products, inerts and solvents, reaction volume, Reaktor volume, chemical reaction, mass, moles, mole fraction, volume, density, molar concentration, mass-concentration, molality, partial pressure, hydrodynamic residence time, space time, extent of reaction, reactor throughput, reactor load, conversion, selectivity, yield, concentration calculations in stationary and flowing multicomponent-mixtures) Stoichiometry and stoichiometric calculations (simple reactions, complex reactions, key reactions, key species, matrix of stoichiometric coefficients, linear dependent and independent reactions, element-species-matrix, row reduced form of a matrix, rank of a matrix, Gauss

Jordan elimination, relation between stoichiometry and kinetics, calculating the extent of reaction from mole number changes in complex reactions)
Thermodynamics (What is thermodynamics?, importance of thermodynamics in chemical reaction engineering, zeroth law of thermodynamics, temperature scales, temperature measurements in praxis, first law of thermodynamics, internal energy, enthalpy, calorimeter, heat of reaction, standard heat of formation, Hess law, heat capacity, Kirchhoff law, standard heat of reaction, pressure dependence of the heat of reaction, second law of thermodynamics, reversible and irreversible processes, entropy, Clausius inequality, free energy, Gibbs Energy, chemical potential, chemical equilibrium, activity, van't Hoff law, calculation of chemical equilibrium, principle of Le Chatelier and Braun, equilibrium calculations in multiple reaction systems, Lagrange Multipliers)
Chemical kinetics (reversible and irreversible reactions, homogeneous and heterogeneous reactions, elementary step, reaction mechanism, microkinetics, macrokinetics, formal kinetics, reaction rate, rate of change of species mole number, Arrhenius-equation, activation energy and pre-exponential factor for komplex reactions, reactions of 0., 1. and 2. order, analytical integration of rate laws, Damköhler-number, differential and integral method of kinetic analysis, laboratory reactors for kinetic measurements, half life, kinetics of complex reactions, parallel reactions, reversible reactions, sequence of reactions, irreversible reaction with pre-equilibrium, reduction of reaction mechanisms, quasi-stationarity principle of Bodenstein, rate limiting step, Michaelis-Menten kinetics, analytical integration of first order differential equations - integrating factor, numerical integration of complex kinetics)
Types of chemical Reaktors (chemical reactors in industry and laboratory, ideal vs. real reaktors, discontinuous, half continuous and continuous reactors, single phase - biphasic- and multiphase reactors, batch-reactor, semi-batch reactor, CSTR, Plug Flow reactor, fixed bed reactor, adiabatic staged reactors, rotating furnaces, fluidized bed reactors, gas-liquid-reactors, multi-phase reactors)
Isothermal ideal reactors (mole-balance of a chemical reactor, mole balance of a batch reactor, integration of the batch reactor mole balance for various kinetics, partial fraction decomposition, mole balance of the semi-batch reactor, mole balance of the plug flow reactor, analogy batch reactor - plug flow reactor, design of plug flow reactors for reactions with volume change and complex reactions, mole balance of a fixed bed reactor, design of a membrane reactor, mole balance of a continuously stirred tank reactor, comparison of CSTR and PFR with respect to conversion and selectivity, mole-balance of a cascade of tank reactors, numerical-interative calculation of a cascade of tank reactors, Newton-Raphson method, graphical analysis of a cascade of tank reactors)
non-isothermal ideal reactors (energy balance of a reactor, adiabatic reactor, adiabatic temperature rise, staged reactor for adiabatic exothermic reactions limited by chemical equilibrium, design of an adiabatic plug flow reactor, Levenspiel-plots, heat transfer through a reactor wall, heat transfer by convection, heat conduction, heat transfer through a cylindrical wall, design of a plug flow reactor in parallel and counter flow, heat balance of the cooling fluid, CSTR with heat exchange, multiple stationary states, ignition-extinction behavior, stability of a CSTR, complex reactions in non-isothermal reactors, optimum temperature profile of a reactor)

Literature:

lecture notes Raimund Horn
skript Frerich Keil
Books:
M. Baerns, A. Behr, A. Brehm, J. Gmehling, H. Hofmann, U. Onken, A. Renken, Technische Chemie, Wiley-VCH
G. Emig, E. Klemm, Technische Chemie, Springer
A. Behr, D. W. Agar, J. Jörissen, Einführung in die Technische Chemie
E. Müller-Erlwein, Chemische Reaktionstechnik 2012, 2. Auflage, Teubner Verlag
J. Hagen, Chemiereaktoren: Auslegung und Simulation, 2004, Wiley-VCH
H. S. Fogler, Elements of Chemical Reaction Engineering, Prentice Hall B
H. S. Fogler, Essentials of Chemical Reaction Engineering, Prentice Hall
O. Levenspiel, Chemical Reaction Engineering, John Wiley & Sons, 1998
L. D. Schmidt, The Engineering of Chemical Reactions, Oxford Univ. Press, 2009
J. B. Butt, Reaction Kinetics and Reactor Design, 2000, Marcel Dekker
R. Aris, Elementary Chemical Reactor Analysis, Dover Pubn. Inc., 2000
M. E. Davis, R. J. Davis, Fundamentals of Chemical Reaction Engineering, McGraw Hill
G. F. Froment, K. B. Bischoff, J. De Wilde, Chemical Reactor Analysis and Design, John Wiley & Sons, 2010
A. Jess, P. Wasserscheid, Chemical Technology An Integrated Textbook, WILEY-VCH

Course: Chemical Reaction Engineering (Fundamentals) (Übung)

Lecturer:

Prof. Raimund Horn

Language:

DE

Cycle:

WS

Content:

Fundamentals of chemical reaction engineering, definitions, calculation of species concentrations (reactor, reaction mixture, reactants, products, inerts and solvents, reaction volume, Reaktor volume, chemical reaction, mass, moles, mole fraction, volume, density, molar concentration, mass-concentration, molality, partial pressure, hydrodynamic residence time, space time, extent of reaction, reactor throughput, reactor load, conversion, selectivity, yield, concentration calculations in stationary and flowing multicomponent-mixtures)
Stoichiometry and stoichiometric calculations (simple reactions, complex reactions, key reactions, key species, matrix of stoichiometric coefficients, linear dependent and independent reactions, element-species-matrix, row reduced form of a matrix, rank of a matrix, Gauss Jordan elimination, relation between stoichiometry and kinetics, calculating the extent of reaction from mole number changes in complex reactions)
Thermodynamics (What is thermodynamics?, importance of thermodynamics in chemical reaction engineering, zeroth law of thermodynamics, temperature scales, temperature measurements in praxis, first law of thermodynamics, internal energy, enthalpy, calorimeter, heat of reaction, standard heat of formation, Hess law, heat capacity, Kirchhoff law, standard heat of reaction, pressure

dependence of the heat of reaction, second law of thermodynamics, reversible and irreversible processes, entropy, Clausius inequality, free energy, Gibbs Energy, chemical potential, chemical equilibrium, activity, van't Hoff law, calculation of chemical equilibrium, principle of Le Chatelier and Braun, equilibrium calculations in multiple reaction systems, Lagrange Multipliers)
Chemical kinetics (reversible and irreversible reactions, homogeneous and heterogeneous reactions, elementary step, reaction mechanism, microkinetics, macrokinetics, formal kinetics, reaction rate, rate of change of species mole number, Arrhenius-equation, activation energy and pre-exponential factor for komplex reactions, reactions of 0., 1. and 2. order, analytical integration of rate laws, Damköhler-number, differential and integral method of kinetic analysis, laboratory reactors for kinetic measurements, half life, kinetics of complex reactions, parallel reactions, reversible reactions, sequence of reactions, irreversible reaction with pre-equilibrium, reduction of reaction mechanisms, quasi-stationarity principle of Bodenstein, rate limiting step, Michaelis-Menten kinetics, analytical integration of first order differential equations - integrating factor, numerical integration of complex kinetics)
Types of chemical Reaktors (chemical reactors in industry and laboratory, ideal vs. real reaktors, discontinuous, half continuous and continuous reactors, single phase - biphasic- and multiphase reactors, batch-reactor, semi-batch reactor, CSTR, Plug Flow reactor, fixed bed reactor, adiabatic staged reactors, rotating furnaces, fluidized bed reactors, gas-liquid-reactors, multi-phase reactors)
Isothermal ideal reactors (mole-balance of a chemical reactor, mole balance of a batch reactor, integration of the batch reactor mole balance for various kinetics, partial fraction decomposition, mole balance of the semi-batch reactor, mole balance of the plug flow reactor, analogy batch reactor - plug flow reactor, design of plug flow reactors for reactions with volume change and complex reactions, mole balance of a fixed bed reactor, design of a membrane reactor, mole balance of a continuously stirred tank reactor, comparison of CSTR and PFR with respect to conversion and selectivity, mole-balance of a cascade of tank reactors, numerical-interative calculation of a cascade of tank reactors, Newton-Raphson method, graphical analysis of a cascade of tank reactors)
non-isothermal ideal reactors (energy balance of a reactor, adiabatic reactor, adiabatic temperature rise, staged reactor for adiabatic exothermic reactions limited by chemical equilibrium, design of an adiabatic plug flow reactor, Levenspiel-plots, heat transfer through a reactor wall, heat transfer by convection, heat conduction, heat transfer through a cylindrical wall, design of a plug flow reactor in parallel and counter flow, heat balance of the cooling fluid, CSTR with heat exchange, multiple stationary states, ignition-extinction behavior, stability of a CSTR, complex reactions in non-isothermal reactors, optimum temperature profile of a reactor)

Literature:

lecture notes Raimund Horn
skript Frerich Keil
Books:
M. Baerns, A. Behr, A. Brehm, J. Gmehling, H. Hofmann, U. Onken, A. Renken, Technische Chemie, Wiley-VCH
G. Emig, E. Klemm, Technische Chemie, Springer
A. Behr, D. W. Agar, J. Jörissen, Einführung in die Technische Chemie
E. Müller-Erlwein, Chemische Reaktionstechnik 2012, 2. Auflage, Teubner Verlag
J. Hagen, Chemiereaktoren: Auslegung und Simulation, 2004, Wiley-VCH
H. S. Fogler, Elements of Chemical Reaction Engineering, Prentice Hall B
H. S. Fogler, Essentials of Chemical Reaction Engineering, Prentice Hall
O. Levenspiel, Chemical Reaction Engineering, John Wiley & Sons, 1998
L. D. Schmidt, The Engineering of Chemical Reactions, Oxford Univ. Press, 2009
J. B. Butt, Reaction Kinetics and Reactor Design, 2000, Marcel Dekker
R. Aris, Elementary Chemical Reactor Analysis, Dover Pubn. Inc., 2000
M. E. Davis, R. J. Davis, Fundamentals of Chemical Reaction Engineering, McGraw Hill
G. F. Froment, K. B. Bischoff, J. De Wilde, Chemical Reactor Analysis and Design, John Wiley & Sons, 2010
A. Jess, P. Wasserscheid, Chemical Technology An Integrated Textbook, WILEY-VCH

Course: Experimental Course Chemical Engineering (Fundamentals) (Laborpraktikum)

Lecturer:

Prof. Raimund Horn, Dr. Achim Bartsch

Language:

DE/EN

Cycle:

SS

Content:

Performing and evaluation of experiments concerning chemical reaction engineering with emphasis on ideal reactors:
* Batch reactor - Estimation of kinetic parameters for the saponification of ethylacetate
*CSTR - Residence time distribution, reaction
*CSTR in Series - Residence time distribution, reaction
* Plug Flow Reactor - Residence time distribution, reaction

Literature:

Levenspiel, O.: Chemical reaction engineering; John Wiley & Sons, New York, 3. Ed., 1999 VTM 309(LB)
Praktikumsskript
Skript Chemische Verfahrenstechnik 1 (F.Keil)

Module: Process and Plant Engineering I

Courses:

Title	Typ	Hrs/wk
Process and Plant Engineering I	Vorlesung	2
Process and Plant Engineering I	Hörsaalübung	1
Process and Plant Engineering I	Gruppenübung	1

Module Responsibility:
Prof. Georg Fieg

Admission Requirements:
none

Recommended Previous Knowledge:
unit operation of thermal an dmechanical separation processes
chemical reactor eingineering

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
students can:
classify and formulate blobal balance equations of chemical processes
specify linear component equations of complex chemical processes
explain linear regression and data reconcilliation problems
explain pfd-diagrams
Capabilities:
students are capable of
- formulation of mass and energy balance equations and estimation of product streams
- estimation of component streams of chemical plants using linear component balance models
- solution of data reconcilliation tasks
- conduction of process synthesis
- economic evaluation of processes and the estimation of production costs

Personal Competence:
Social Competence:
Autonomy:

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Chemical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Bioprocess Engineering: Compulsory
Bioprocess Engineering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (English program): Vertiefung Chemical Engineering: Compulsory
Process Engineering: Kernqualifikation: Compulsory

Course: Process and Plant Engineering I (Vorlesung)

Lecturer:
Prof. Georg Fieg

Language:
DE

Cycle:
SS

Content:

1. **Introduction**
   Structure and operation of production plants
   Operational business process
   Technical process design
   Motivation and targets of process development

Life cycle of production plants

2. **Engineering methods and tools**
   Mass and energy balances
   Strategies of process synthesis
   Graphical representation of processes
   Multidimensional regression
   Data reconciliation and data validation
3. **Process Synthesis**
   Decision levels
   Experimental process development
   Reactor synthesis
   Synthesis of separation processes (process alternatives and criteria for selection)
   Integration of reaction systems/separation systems (interactions, recycle streams)
4. **Process safety**
5. **Cost estimation of production plants**
   Production costs, capital costs, economic evaluation

Literature:

S.D. Barnicki, J.R. Fair, Ind. End. Chem., 29(1990), S. 421, Ind. End. Chem., 31(1992), S. 1679
H. Becker, S. Godorr, H. Kreis, Chemical Engineering, January 2001, S. 68-74
Behr, W. Ebbers, N. Wiese, Chem. -Ing.-Tech. 72(2000)Nr. 10, S.1157
E. Blass, Entwicklung verfahrenstechnischer Prozesse, Springer-Verlag, 2. Auflage 1997
M. H. Bauer, J. Stichlmair, Chem.-Ing.-Tech., 68(1996), Nr. 8, 911-916
R. Dittmeyer, W. Keim, G. Kreysa, A. Oberholz, Chemische Technik. Prozesse und Produkte, Band 2, Neue Technologien, 5. Auflage, Wiley-VCH GmbH&Co.KGaA, Weinheim, 2004
J.M. Douglas, Conceptual Design of Chemical Processes, Mc Graw-Hill, NY, 1988
G. Fieg, Inz. Chem. Proc., 5(1979), S.15-19
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G. Fieg, Heat and Mass Transfer 32(1996), S. 205-213
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G. Gruhn, Vorlesungsmanuskript „Prozess- und Anlagentechnik, TU Hamburg-Harburg
D. Hairston, Chemical Engineering, October 2001, S. 31-37
J.L.A. Koolen, Design of Simple and Robust Process Plants, Wiley-VCH, Weinheim, 2002
J. Krekel, G. Siekmann, Chem. -Ing.-Tech. 57(1985)Nr. 6, S. 511
K. Machej, G. Fieg, J. Wojcik, Inz. Chem. Proc., 2(1981), S.815-824
S. Meier, G. Kaibel, Chem. -Ing.-Tech. 62(1990)Nr. 13, S.169
J. Mittelstraß, Chem. -Ing.-Tech. 66(1994), S. 309
P. Li, M. Flender, K. Löwe, G. Wozny, G. Fieg, Fett/Lipid 100(1998), Nr. 12, S. 528-534
G. Kaibel, Dissertation, TU München, 1987
G. Kaibel, Chem.-Ing.-Tech. 61 (1989), Nr. 2, S. 104-112
G. Kaibel, Chem. Eng. Technol., 10(1987), Nr. 2, S. 92-98
H.J. Lang, Chem. Eng. 54(10),117, 1947
H.J. Lang, Chem. Eng. 55(6), 112, 1948
F. Lestak, C. Collins, Chemical Engineering, July 1997, S. 72-76

Course: Process and Plant Engineering I (Übung)

Lecturer:
Prof. Georg Fieg

Language:
DE

Cycle:
SS

Content:

1. **Introduction**
   Structure and operation of production plants
   Operational business process
   Technical process design
   Motivation and targets of process development
   Life cycle of production plants
2. **Engineering methods and tools**
   Mass and energy balances
   Strategies of process synthesis

Graphical representation of processes
Multidimensional regression
Data reconciliation and data validation

3. **Process Synthesis**
   Decision levels
   Experimental process development
   Reactor synthesis
   Synthesis of separation processes (process alternatives and criteria for selection)
   Integration of reaction systems/separation systems (interactions, recycle streams)
4. **Process safety**
5. **Cost estimation of production plants**
   Production costs, capital costs, economic evaluation

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H.J. Lang, Chem. Eng. 54(10),117, 1947
H.J. Lang, Chem. Eng. 55(6), 112, 1948
F. Lestak, C. Collins, Chemical Engineering, July 1997, S. 72-76

Course: Process and Plant Engineering I (Übung)

Lecturer:
Prof. Georg Fieg

Language:
DE

Cycle:
SS

Content:

1. **Introduction**
   Structure and operation of production plants
   Operational business process
   Technical process design
   Motivation and targets of process development
   Life cycle of production plants
2. **Engineering methods and tools**
   Mass and energy balances
   Strategies of process synthesis
   Graphical representation of processes
   Multidimensional regression
   Data reconciliation and data validation
3. **Process Synthesis**

Decision levels
Experimental process development
Reactor synthesis
Synthesis of separation processes (process alternatives and criteria for selection)
Integration of reaction systems/separation systems (interactions, recycle streams)

4. **Process safety**
5. **Cost estimation of production plants**
   Production costs, capital costs, economic evaluation

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S.D. Barnicki, J.R. Fair, Ind. End. Chem., 29(1990), S. 421, Ind. End. Chem., 31(1992), S. 1679
H. Becker, S. Godorr, H. Kreis, Chemical Engineering, January 2001, S. 68-74
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M. H. Bauer, J. Stichlmair, Chem.-Ing.-Tech., 68(1996), Nr. 8, 911-916
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G. Fieg, Heat and Mass Transfer 32(1996), S. 205-213
G. Fieg, Chem. Eng. Processing, Vol. 41/2(2001), S. 123-133
U.H. Felcht, Chemie eine reife Industrie oder weiterhin Innovationsmotor, Universitätsbuchhandlung Blazek und Bergamann, Frankfurt, 2000
J.P. van Gigch, Systems Design, Modeling and Metamodeling, Plenum Press, New York, 1991
T.F. Edgar, D.M. Himmelblau, L.S. Lasdon, Optimization of Chemical Processes, McGraw-Hill, 2001
G. Gruhn, Vorlesungsmanuskript „Prozess- und Anlagentechnik, TU Hamburg-Harburg
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J.L.A. Koolen, Design of Simple and Robust Process Plants, Wiley-VCH, Weinheim, 2002
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K. Machej, G. Fieg, J. Wojcik, Inz. Chem. Proc., 2(1981), S.815-824
S. Meier, G. Kaibel, Chem. -Ing.-Tech. 62(1990)Nr. 13, S.169
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G. Kaibel, Chem. Eng. Technol., 10(1987), Nr. 2, S. 92-98
H.J. Lang, Chem. Eng. 54(10),117, 1947
H.J. Lang, Chem. Eng. 55(6), 112, 1948
F. Lestak, C. Collins, Chemical Engineering, July 1997, S. 72-76

Module: Particle Technology and Solids Process Engineering

Courses:

Title	Typ	Hrs/wk
Particle Technology I	Vorlesung	2
Particle Technology I	Gruppenübung	1
Particle Technology I	Laborpraktikum	2

Module Responsibility:
Prof. Stefan Heinrich

Admission Requirements:
-

Recommended Previous Knowledge:

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
After successful completion of the module students are able to

- name and explain processes and unit-operations of solids process engineering,
- characterize particles, particle distributions and to discuss their bulk properties

Capabilities:
Students are able to

- choose and design apparatuses and processes for solids processing according to the desired solids properties of the product
- asses solids with respect to their behavior in solids processing steps

Personal Competence:
Social Competence:
Autonomy:

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 110, Study Time in Lecture: 70

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Chemical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (German program): Vertiefung Energy and Enviromental Engineering: Compulsory
Bioprocess Engineering: Kernqualifikation: Compulsory
Energy and Environmental Engineering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (English program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (English program): Vertiefung Chemical Engineering: Compulsory
Process Engineering: Kernqualifikation: Compulsory

Course: Particle Technology I (Vorlesung)

Lecturer:
Prof. Stefan Heinrich

Language:
DE

Cycle:
SS

Content:

- Description of particles and particle distributions
- Description of a separation process
- Description of a particle mixture
- Particle size reduction
- Agglomeration, particle size enlargement

- Storage and flow of bulk solids
- Basics of fluid/particle flows
- classifying processes
- Separation of particles from fluids
- Basic fluid mechanics of fluidized beds
- Pneumatic and hydraulic transport

Literature:

Schubert, H.; Heidenreich, E.; Liepe, F.; Neeße, T.: Mechanische Verfahrenstechnik. Deutscher Verlag für die Grundstoffindustrie, Leipzig, 1990.
Stieß, M.: Mechanische Verfahrenstechnik I und II. Springer Verlag, Berlin, 1992.

Course: Particle Technology I (Übung)

Lecturer:

Prof. Stefan Heinrich

Language:

DE

Cycle:

SS

Content:

- Description of particles and particle distributions
- Description of a separation process
- Description of a particle mixture
- Particle size reduction
- Agglomeration, particle size enlargement
- Storage and flow of bulk solids
- Basics of fluid/particle flows
- classifying processes
- Separation of particles from fluids
- Basic fluid mechanics of fluidized beds
- Pneumatic and hydraulic transport

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Schubert, H.; Heidenreich, E.; Liepe, F.; Neeße, T.: Mechanische Verfahrenstechnik. Deutscher Verlag für die Grundstoffindustrie, Leipzig, 1990.
Stieß, M.: Mechanische Verfahrenstechnik I und II. Springer Verlag, Berlin, 1992.

Course: Particle Technology I (Laborpraktikum)

Lecturer:

Prof. Stefan Heinrich

Language:

DE

Cycle:

SS

Content:

- Sieving
- Bulk properties
- Size reduction
- Mixing
- Gas cyclone
- Blaine-test, filtration
- Sedimentation

Literature:

Schubert, H.; Heidenreich, E.; Liepe, F.; Neeße, T.: Mechanische Verfahrenstechnik. Deutscher Verlag für die Grundstoffindustrie, Leipzig, 1990.
Stieß, M.: Mechanische Verfahrenstechnik I und II. Springer Verlag, Berlin, 1992.

Courses:

Title	Typ	Hrs/wk
Introduction to Management	Vorlesung	4
Project Entrepreneurship	Problemorientierte Lehrveranstaltung	2

Module Responsibility:
Prof. Kathrin Fischer

Admission Requirements:
None

Recommended Previous Knowledge:
Basic Knowledge of Mathematics and Business

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
After taking this module, students know the important basics of many different areas in Business and Management, from Planning and Organisation to Marketing and Innovation, and also to Investment and Controlling. In particular they are able to

- explain the differences between Economics and Management and the sub-disciplines in Management and to name important definitions from the field of Management
- explain the most important aspects of and goals in Management and name the most important aspects of entreprneurial projects
- describe and explain basic business functions as production, procurement and sourcing, supply chain management, organization and human ressource management, information management, innovation management and marketing
- explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives and uncertainty, and explain some basic methods from mathematical Finance
- state basics from accounting and costing and selected controlling methods.

Capabilities:
Students are able to analyse business units with respect to different criteria (organization, objectives, strategies etc.) and to carry out an Entrepreneurship project in a team. In particular, they are able to

- analyse Management goals and structure them appropriately
- analyse organisational and staff structures of companies
- apply methods for decision making under multiple objectives, under uncertainty and under risk
- analyse production and procurement systems and Business information systems
- analyse and apply basic methods of marketing
- select and apply basic methods from mathematical finance to predefined problems
- apply basic methods from accounting, costing and controlling to predefined problems

Personal Competence:
Social Competence:
Students are able to

- work successfully in a team of students
- to apply their knowledge from the lecture to an entrepreneurship project and write a coherent report on the project
- to communicate appropriately and
- to cooperate respectfully with their fellow students.

Autonomy:
Students are able to

- work in a team and to organize the team themselves
- to write a report on their project.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 96, Study Time in Lecture: 84

Assignment for the Following Curricula:
General Engineering Science (German program): Vertiefung Electrical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Computer Science and Engineering: Compulsory
General Engineering Science (German program): Vertiefung Chemical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Bioprocess Engineering: Compulsory

General Engineering Science (German program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (German program): Vertiefung Civil- and Enviromental Engeneering: Compulsory
General Engineering Science (German program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (German program): Vertiefung Naval Architecture: Compulsory
Civil- and Environmental Engeneering: Kernqualifikation: Compulsory
Bioprocess Engineering: Kernqualifikation: Compulsory
Computer Science: Kernqualifikation: Compulsory
Electrical Engineering: Kernqualifikation: Compulsory
Electrical Engineering myTrack: Kernqualifikation: Compulsory
Energy and Environmental Engineering: Kernqualifikation: Compulsory
General Engineering Science (English program): Vertiefung Civil- and Enviromental Engeneering: Compulsory
General Engineering Science (English program): Vertiefung Bioprocess Engineering: Compulsory
General Engineering Science (English program): Vertiefung Electrical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Energy and Enviromental Engineering: Compulsory
General Engineering Science (English program): Vertiefung Computer Science and Engineering: Compulsory
General Engineering Science (English program): Vertiefung Mechanical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Biomedical Engineering: Compulsory
General Engineering Science (English program): Vertiefung Naval Architecture: Compulsory
General Engineering Science (English program): Vertiefung Chemical Engineering: Compulsory
Computational Science and Engineering: Kernqualifikation: Compulsory
Logistics and Mobility: Kernqualifikation: Compulsory
Mechanical Engineering: Kernqualifikation: Compulsory
Mechatronics: Kernqualifikation: Compulsory
Naval Architecture: Kernqualifikation: Compulsory
Technomathematics: Kernqualifikation: Compulsory
Process Engineering: Kernqualifikation: Compulsory

Course: Introduction to Management (Vorlesung)

Lecturer:
Prof. Kathrin Fischer, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Cornelius Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona

Language:
DE

Cycle:
WS/SS

Content:

- Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management
- Important definitions from Management,
- Developing Objectives for Business, and their relation to important Business functions
- Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supply Chain Management, Innovation Management, Marketing and Sales
  Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management
- Definitions as information, information systems, aspects of data security and strategic information systems
- Definition and Relevance of innovations, e.g. innovation opporunities, risks etc.
- Relevance of marketing, B2B vs. B2C-Marketing
- different techniques from the field of marketing (e.g. scenario technique), pricing strategies
- important organizational structures
- basics of human ressource management
- Introduction to Business Planning and the steps of a planning process
- Decision Analysis: Elements of decision problems and methods for solving decision problems
- Selected Planning Tasks, e.g. Investment and Financial Decisions
- Introduction to Accounting: Accounting, Balance-Sheets, Costing
- Relevance of Controlling and selected Controlling methods
- Important aspects of Entrepreneurship projects

Literature:
Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008
Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003
Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006.
Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001.
Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgart 2008.
Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeine Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005.
Weber, J., Schäffer, U. : Einführung in das Controlling, 12. Auflage, Stuttgart 2008.
Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006.

Course: Project Entrepreneurship (Problemorientierte Lehrveranstaltung)

Lecturer:
Prof. Christoph Ihl

Language:
DE

Cycle:
WS/SS

Content:
In this project module, students work on an Entrepreneurship project. They are required to go through all relevant steps, from the first idea to the concept, using their knowledge from the corresponding lecture.
Project work is carried out in teams with the support of a mentor.

Literature:
Relevante Literatur aus der korrespondierenden Vorlesung.

Thesis

Module: Bachelor Thesis

Courses:

Title	Typ	Hrs/wk

Module Responsibility:
Professoren der TUHH

Admission Requirements:

Recommended Previous Knowledge:

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:

- The students can select, outline and, if need be, critically discuss the most important scientific fundamentals of their course of study (facts, theories, and methods).
- On the basis of their fundamental knowledge of their subject the students are capable in relation to a specific issue of opening up and establishing links with extended specialized expertise.
- The students are able to outline the state of research on a selected issue in their subject area.

Capabilities:

- The students can make targeted use of the basic knowledge of their subject that they have acquired in their studies to solve subject-related problems.
- With the aid of the methods they have learnt during their studies the students can analyze problems, make decisions on technical issues, and develop solutions.
- The students can take up a critical position on the findings of their own research work from a specialized perspective.

Personal Competence:
Social Competence:

- Both in writing and orally the students can outline a scientific issue for an expert audience accurately, understandably and in a structured way.
- The students can deal with issues in an expert discussion and answer them in a manner that is appropriate to the addressees. In doing so they can uphold their own assessments and viewpoints convincingly.

Autonomy:

- The students are capable of structuring an extensive work process in terms of time and of dealing with an issue within a specified time frame.
- The students are able to identify, open up, and connect knowledge and material necessary for working on a scientific problem.
- The students can apply the essential techniques of scientific work to research of their own.

ECTS-Credit points:
12 LP

Examination:
lt. FSPO

Workload in Hours:
Indipendent Study Time: 360, Study Time in Lecture: 0

Assignment for the Following Curricula:
General Engineering Science (German program): Abschlussarbeit: Compulsory
Civil- and Environmental Engeneering: Abschlussarbeit: Compulsory
Bioprocess Engineering: Abschlussarbeit: Compulsory
Computer Science: Abschlussarbeit: Compulsory
Electrical Engineering: Abschlussarbeit: Compulsory
Electrical Engineering myTrack: Abschlussarbeit: Compulsory
Energy and Environmental Engineering: Abschlussarbeit: Compulsory
General Engineering Science (English program): Abschlussarbeit: Compulsory
Computational Science and Engineering: Abschlussarbeit: Compulsory
Logistics and Mobility: Abschlussarbeit: Compulsory
Mechanical Engineering: Abschlussarbeit: Compulsory
Mechatronics: Abschlussarbeit: Compulsory
Naval Architecture: Abschlussarbeit: Compulsory

Technomathematics: Abschlussarbeit: Compulsory
Process Engineering: Abschlussarbeit: Compulsory